Skills Requirements for Business Intelligence, Business Analytics, Big Data Analytics, and Data Science: An Analysis of South African Professionals

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Abstract

This study aimed at investigating the requisite skills and their overlaps for Business Intelligence (BI), Business Analytics (BA), Big Data Analytics (BDA), and Data Science (DS) professionals in South Africa. Studies on benefits, challenges, and concepts on BI and Analytics have been conducted, but few contributions have been made on requisite skills for BI, BA, BDA, and DS.

A multi-method approach was adopted using firstly online job advertisement analysis followed by the Delphi technique. A total of 482 online job advertisements were collected for analysis by using LinkedIn and Indeed.com. Descriptive analysis was used to analyze data from online job advertisements. Thematic analysis was used for the categorization of skills. For the Delphi technique, the final number of data professionals were 21 (7 experts from BI, 7 from BA/BDA and 7 from DS).

Findings show that data professionals are required to have skills in programming languages such as SQL, Python, R, and Java, specifically for BA, BDA, and DS. They are required to be holders of a degree in Information Systems (IS) or Computer Science or Engineering. The significant skills categories which were shown as needed across all the domains were **Data manipulation and processing** (*Manipulate data using SQL, Transform data from different sources and load it to extract insights (ETL), Formulate validation strategies and methods to ensure accurate and reliable data, Ensure correct data and error handling, Perform data analysis and validation,* **Soft skills (***Communicate effectively, verbally and in writing, Exhibit time management skills, Prioritize workload and work well under pressure, Demonstrate problem-solving skills, Demonstrate excellent analytical skills, Be able to work independently, Apply creativity and innovation),* **Designing and Coding** *(Apply agile development processes to achieve outstanding data solutions, Perform data modelling with SQL),* and **Reporting** *(Extract insights and trends from data).* This study contributes to descriptive knowledge by providing insight into BI, BA, BDA, and DS requisite skills in South Africa.

Acknowledgements

Table of Contents

List of Tables

List of Figures

CHAPTER 1: INTRODUCTION

1.1 Research Background and Context

Business intelligence (BI), Business Analytics (BA), Data Science (DS), and Big Data Analytics (BDA) have become some of the most interesting topics among researchers (Gupta, Goul, & Dinter, 2015; Mikalef, Framnes, Danielsen, Krogstie, & Olsen, 2017; Pedro, Brown, & Hart, 2019).

BI is considered a vital element in an organization to make informed operational and strategic decisions (Gupta et al., 2015; Larson & Chang, 2016). BI is the technology-driven process of analyzing data and delivering useful, actionable information to executives, managers, and others (Trieu, 2017). BI enables organizations to collect, analyze and interpret data for current and future events (Gupta et al., 2015; Lim, Chen, & Chen, 2013). It focuses on adding value using BI tools and principles. Companies become highly competitive in the business environment using BI tools such as Cognos and Tableau to identify possible threats and opportunities. BI is viewed as one of the drivers for business success in organizations (Hans & Mnkandla, 2016; Olszak, 2016). However, some scholars perceive that the value gained from BI adoption contributes less to the performance of an organization (Günther, Mehrizi, Huysman, & Feldberg, 2017). In addition, Olszak (2016) differs on the benefits of BI by arguing that not all BI applications implemented in organizations are successful. A skills shortage has been noted in BI (Adelzadeh, 2017). Organisations struggle to find the right people with the right skillset (Uen, Ahlstrom, Chen, & Liu, 2015). Moreover, managers are searching for experts who can utilize business investigation tools to "analyse data and make sense of what analyses are needed " and give the usefulness of the outcome (Power, Heavin, McDermott, & Daly, 2018.p.40).

BA is defined as the process by which organizations use statistical methods and technologies to analyze historical data and generate new insights**.** BA is viewed as the same as BI (Bayrak, 2015). The use of sophisticated tools in BA however makes it different from BI. The focus of BA is to answer questions on why things happened in the past, unlike BI, which seeks to answer what happened. Furthermore, both BI and BA are important in providing solutions for data management in organisations as they are both used for decision-making (Gupta et al., 2015). Whitelock (2018) postulates that firms face a big challenge in recruiting people with BA skills thus, employers are pushed to source skills outside of South Africa.

Big data refers to large amounts of data gathered from different sources such as social media, transactions, and real-time sensors. The three "Vs have traditionally characterized big data", namely: volume of data, velocity, and variety (Mikalef et al., 2017; Pedro et al., 2019). However, recent literature shows that big data can now be defined using seven 'V's, which is an addition of 3Vs to the previous ones, namely: veracity, validity, value, and visualization (Gandomi & Haider, 2015; Singh & Singla, 2015; Rahman, Begum & Ahmed, 2016; Walker & Brown, 2019).

"Businesses find themselves in a situation where opportunity from big data exists. On the other hand, analytical talent and, to some extent, technology is lagging" (Phillips-Wren, Iyer, Kulkarni, & Ariyachandra, 2015.p.451), which then poses a question on why these applications are failing. Furthermore, BDA requires individuals with new specialized aptitudes because of BDA uniqueness in character (Phillips-Wren et al., 2015). The uniqueness is presented by the multiple data sources and advanced tools employed, such as machine learning (Liang & Liu, 2018; Olszak, 2016). Different organizations in South Africa understand the value of advanced analytics and the

potential technologies such as big data, however the adoption is low due to lack of skills and expertise (Malaka & Brown, 2015; Duan & Xiong, 2015).

The introduction of BDA has also brought about the new buzzword "Data science". Data science (DS) can be defined as "the set of fundamental principles that support and guide the principled extraction of information and knowledge from data" (Provost & Fawcett (2013.p.2). A data scientist uses sophisticated tools to get insights from both structured and unstructured data (Cao, 2017). Kim, Zimmermann, DeLine & Begel, (2016) highlight analytical skills as one of the challenges companies face in finding data scientists. "Skills shortages are an issue with regards to roles such as Data Scientists,Programmers, Modellers and Analysts" (Malaka & Brown, 2015.p.3). Literature shows that few studies have investigated BI, BA, BDA, and DS skills holistically (Debortoli, Müller, & vom Brocke, 2014; Mikalef et al., 2017). However, existing research emphasizes BI, BA, DS, and BDA challenges, concepts, and benefits. Still, few contributions have been made on requisite skills for BI, BA, BDA and DS professionals and their differentiation. Mikalef et al. (2017) studied DS skills using surveys and industry experts to gather the skills requirements. The study gathered skills from industry specialists as a starting point. The purpose of this research is three-fold: (1) to identify specific skillsets for BI, BA, DS and BDA (2) to establish any overlapping skills in BI, BA, DS, and BDA domains (3) to identify any sub-profiles within the roles for BI, BA, DS and BDA.

1.2 Research Question and Objectives

This study aims to answer the following descriptive research question:

1. What are the key skills required by BI, BA, BDA, and DS professionals to perform their jobs in South Africa?

The following are subsections of the main research question:

- What core skills are required in BI, BA, BDA, and DS?
- What are the overlapping skills among BI, BA, BDA, and DS?
- What sub-profiles are within BI, BA, BDA, and DS roles?

The main objectives of the research are:

i.   Identify the requisite skills for BI, BA, BDA, and DS professionals.
ii. Establish the differences and similarities in BI, BA, BDA, and DS skills.
iii. Identify sub-profiles within the roles for BI, BA, BDA, and DS.

1.3 Research Overview

Chapter 2- will provide a literature review and description of the conceptual model.

Chapter 3-will address the research design, a methodology that will explain the underlying research philosophy and how it influenced the choice of methods, techniques and analysis employed.

Chapter 4-will provide detailed research findings using descriptive analysis and thematic analysis and will present the results.

Chapter 5-will provide a summary of research findings, limitations, implications, and research future work.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

The literature review section was conducted to identify studies and methods employed for requisite skills in South Africa in areas of BI, BA, BDA, and DS as well as the current state of the critical skills. This literature review chapter discusses how the literature review was conducted, skills shortages in South Africa, definition of key terms, and the development of a conceptual model.

The literature review employed a hermeneutic approach in which two main cycles are involved - i.e., *search and acquisition* and *analysis and interpretation* (Boell, 2014; Baghizadeh, Cecez-Kecmanovic & Schlagwein, 2020), as shown in Figure 1 below.
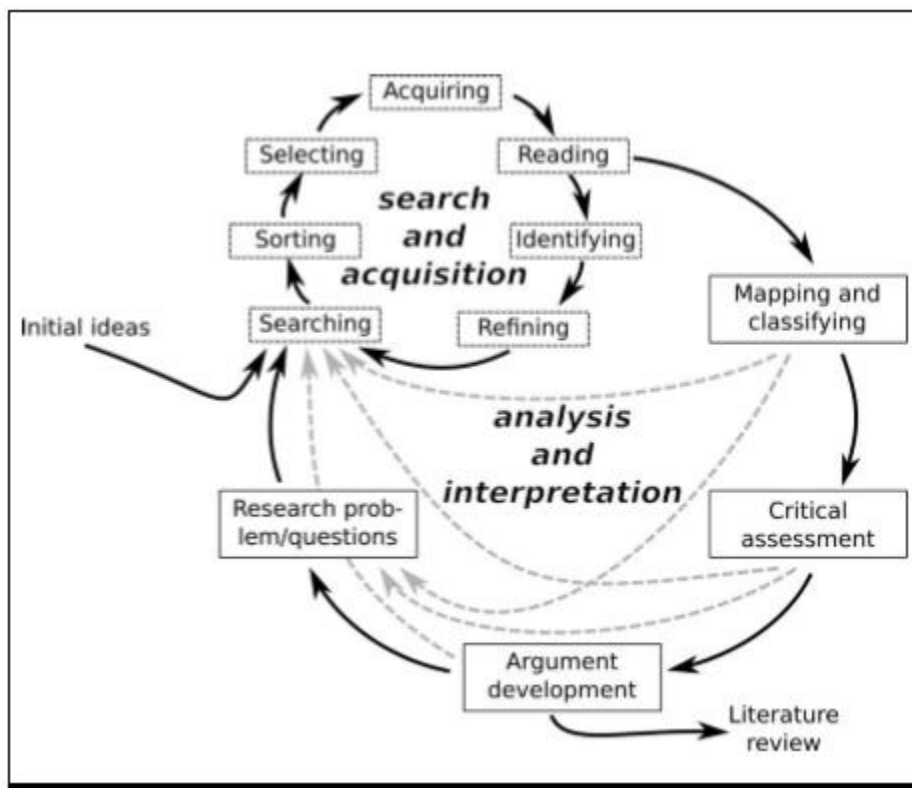
Figure 1: Hermeneutic circle for the literature review process (Baghizadeh et al., 2020)

- Search and acquisition

The first cycle of the hermeneutic approach, "search and acquisition," comprised of different activities, namely: searching, sorting, selecting, and reading, and refining of papers (Baghizadeh, Cecez-Kecmanovic, & Schlagwein, 2020).

The initial literature search was conducted on relevant journal papers, books, and conference papers by searching relevant keywords, i.e., Business Intelligence, Business Analytics, Data Science, and Big Data Analytics. The first search platform used was Google scholar to identify papers; the researcher scanned through the abstract, introduction and conclusion of the papers to get an idea of what the paper addresses.

The next step was the acquisition of papers that were not accessible and required a specific fee to get access. The university online library provided access to these materials. Additionally, the snowballing technique was used to find additional sources that use other sources cited in the reference list of other relevant papers related to BI, BA, DS, and BDA (Baghizadeh et al., 2020).

- Analysis and interpretation

The giant circle is the "analysis and interpretation." The process is iterative as additional searches and readings were found and added to the review. Activities in the cycle include mapping and classifying, critical assessment of ideas, and the argument development which shapes the study of literature. The identification and classification of ideas were made with the help of an Excel spreadsheet by making distinct columns for definitions, concepts, authors, context, and published dates and the formulation of arguments that emerged from the literature. The following section will discuss the major concepts as identified in the literature.

2.2 Skills shortages in South Africa
South Africa has a significant skills shortage particularly for the fourth industrial revolution in areas such as Artificial intelligence, robotics, and big data (Sutherland, 2020). Additionally, the South African government has acknowledged a critical shortage of qualified ICT workers in South Africa (Kirlidog, van der Vyver, Zeeman & Coetzee, 2018). On the other hand, the majority of citizens often lack basic skills. Furthermore, an increase in demand for basic and especially advanced technical skills is expected**.** The widespread use of computers and electronic data processing has led to discussions and predictions about the post-industrial and information-oriented societies **(**Sutherland, 2020). Simply put, "all recent studies and surveys confirm what we already know about scarce skills – management, engineering and IT are key areas of shortage" (Sutherland, 2020.p. 2).
A skills shortage has been noted in BI (Adelzadeh, 2017). South African organisations have access to data but fail to transform it into useful information through BI technology because they fail to realize its benefit. Additionally, where BI technology has been installed, a lack of skills has been noted (Dawson & Van Belle, 2013). The skills gap in South Africa is "an amorphous concept" that includes many specific elements, but at its core is the idea that demand for specific skills exceeds supply (Shava & Clementine 2016). Companies are starting to concentrate on big data technologies thus requiring the involvement of Data Scientists (Kotzé, 2017).
Due to the rising demand for Data Scientists, countries like South Africa need more universities to offer Data Science bachelors' degrees (Liebenberg, Janet; Gruner & Stefan 2017). Given the novel nature of big data and the fact that so many different sectors are currently looking for people with data analytics expertise, there is a BDA skills shortage. The skills shortage is a problem related to roles such as Data Scientist, Programmer**,** Modeler, and Analyst **(**Malaka & Brown, 2015). Technical skills, managerial skills, business analytics, and business knowledge are key skills an individual should possess in the field of BDA (Malaka & Brown, 2015).

2.3 Business Intelligence
Rouhani, Ashrafi, Ravasan, & Afshari, (2016) state that BI encompasses the use of applications, tools, best practices to make an informed decision in an organization. BI seeks to make use of historical data to answer questions like, "What happened?", "When did it happen", "Who was affected by this?" (Rouhani et al., 2016; Dedić & Stanier, 2017). The utilization of BI tools, for example, IBM, Cognos, and Tableau help administrators to plan the best way to be serious in the

business condition by distinguishing openings and dangers before their rivals do (Hans & Mnkandla, 2016). Bl is being used as a strategic tool for the success of organizations (Gaardboe & Svarre, 2017). BI seeks to provide companies with informed decision-making using tools such as Tableau.

While using BI systems, employees need to have experience with the technology involved for successful results. Organizations should invest in their employees by continuously providing analytical skills as new technologies emerge (Schüritz, Brand, Satzger & Bischhoffshausen, 2017). BI focuses more on retrospective issues to make informed decisions; hence shifting to prospective events will be more beneficial for companies to predict the future and act promptly. Companies value data as their biggest asset and employ analytics tools to get insights.

2.3.1 Business Intelligence skills

Current research has focused on BI skills requirements using interviews and job advertisements (De Jager & Brown, 2016; Kusena & Brown, 2020). BI's major skills categories identified by Kusena & Brown (2020) are summarized in Table 1 below.

Table 1: BI Skills categories (De Jager & Brown, 2016)

Skills Category	References
Strategy	Kusena &Brown, 2020
Measure success and progress of the business,	De Jager &Brown, 2016
Think strategically	De Jager &Brown, 2016
Control budgeting and forecasting for BI projects	De Jager &Brown, 2016
Link BI to corporate strategy	De Jager &Brown, 2016
Project management	Kusena & Brown, 2020
Define BI project scope	De Jager &Brown, 2016
Plan and execute a BI project	De Jager &Brown, 2016
Adapt to, and manage change and expectations concerning BI delivery	De Jager &Brown, 2016
Manage change with regards to BI operational and project requirements	De Jager &Brown, 2016
Negotiate and influence change	De Jager &Brown, 2016
Prioritize business requests, Manage projects	De Jager &Brown, 2016
Business Analysis	Kusena &Brown, 2020
Identify and define the needs of a business	De Jager &Brown, 2016
Understand and analyze business processes	De Jager &Brown, 2016
Identify and define business BI requirements through communicative processes	De Jager &Brown, 2016
Elicit user requirements	De Jager &Brown, 2016
Design and Coding	Kusena & Brown, 2020

Apply design principles to the development of BI solutions	De Jager &Brown, 2016
Manage data quality	De Jager &Brown, 2016
Establish BI standards and best practice	De Jager &Brown, 2016
Design IT infrastructure	De Jager &Brown, 2016
Reporting	Kusena & Brown
Incorporate new changes in BI reports	De Jager &Brown, 2016
Extract data	De Jager &Brown, 2016
identify business improvements based on the data	De Jager &Brown, 2016
Analytics	Kusena &Brown, 2020
Apply data mining techniques, text mining, and statistical analysis for effective decision-making	De Jager &Brown, 2016
Identify, discover and explore patterns	De Jager &Brown, 2016
Apply statistical techniques to data	De Jager &Brown, 2016
Knowledge Management	Kusena & Brown, 2020
Learn new emerging skills, Provide training to BI teams and BI users	De Jager &Brown, 2016
Soft skills	Kusena & Brown
Communicate effectively	De Jager &Brown, 2016
Work in teams	De Jager &Brown, 2016
Apply interpersonal skills	De Jager &Brown, 2016
Apply problem-solving techniques	De Jager &Brown, 2016

2.4 The Genesis of Business Analytics

To better understand Business Analytics skills, a brief background of its evolution is discussed. Thereafter, Business Analytics skills are explained in detail. Analytics evolved between the 1970s and 1980s. Figure 2 shows the evolution of Analytics. The timeline for Business Analytics is determined by the complexity of techniques that are applied to data (Vanani & Mohammadipour, 2019). BA progressed from three distinct phases: Business Intelligence, Big Data Analytics, and Data-enriched offerings (Attaran & Attaran, 2018; Chen, Chiang, & Storey, 2012; Vanani & Mohammadipour, 2019).
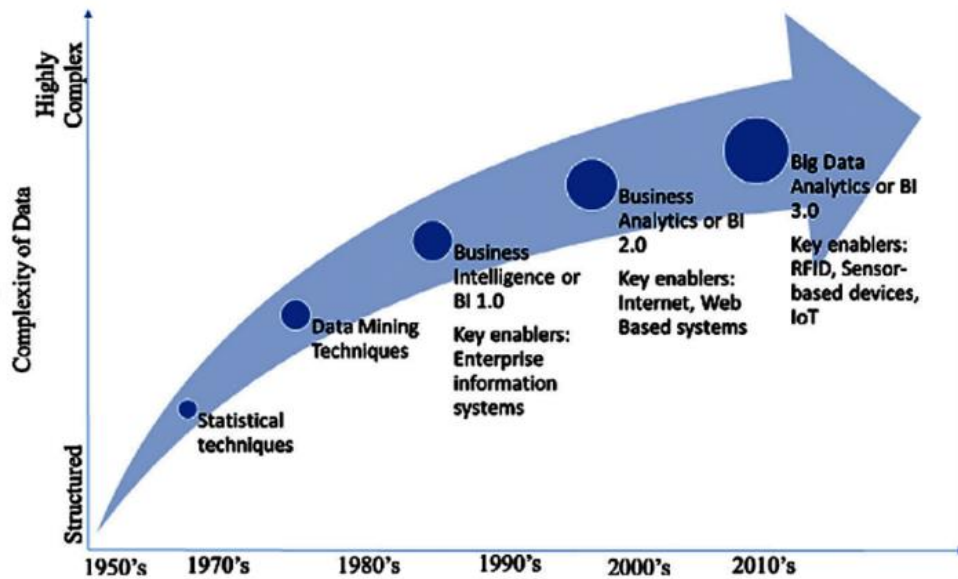
Figure 2 : The Genesis of Business Analytics (Attaran & Attaran, 2018; Hassan, 2019; Vanani & Mohammadipour, 2019).

- Analytics 1.0 Era of Business intelligence

Techniques applied to the data are different to the ones being used nowadays. During the 1990s, analytical techniques were based on statistical methods, which were initially developed in the 1970s. During the 1980s, data mining techniques were used (Chen et al., 2012; Vanani & Mohammadipour, 2019). By the 1990s, enterprise information systems were key enablers for BI. Data for enterprise information systems was integrated and converted using tools such as Extraction, Transformation, and Load (ETL), (Chen et al., 2012; Elgendy & Elragal, 2014). Traditional data mining methods were designed for centralized databases but will not work for large data sets, (Tsai, Lai, Chao, & Vasilakos, 2016). Business intelligence was also known as Decision Support System due to its use of dashboards to visualize data (Hassan, 2019).

- Analytics 2.0

Analytics 2.0 emerged in the early 2000s when there was an increase in web-based technologies, (Chen et al., 2012). The internet and web-based technologies created vast amounts of data through user-generated content collected via social media sites such as Facebook and blogs. In 2004, user-generated content increased due to web 2.0 applications (Chen et al., 2012). Analytics 2.0 mainly focused on web-based applications and unstructured content.

- Analytics 3.0

The key enablers for this phase were radio frequency identification (RFID), sensor-based devices, and the internet of things (IoT) (Attaran & Attaran, 2018). This is where the current big data issue is based. A large amount of data is being collected using smartphones, tablets, and iPads. The majority of people own a mobile phone which has access to the internet, and more user-generated content is created every second (Chen et al., 2012).

7

2.5 Business Analytics
Business Analytics (BA) seeks to improve or add value to raw data by applying its sophisticated tools, applications, techniques, and expertise to create answers for business issues (Whitelock, 2018). BA requires technical and business skills (Sun, Strang & Firmin, 2017). BA uses data analytics applications, including big data analytics, in business. BA relies heavily on statistical, quantitative, and predictive models to make decisions, and tools such as machine learning, and mathematical methods are also applied (Delen &Ram, 2018). Bayrak (2015) noted that BI and BA could be viewed as the same thing, using terms interchangeably and having the same end goal. To add on, Kusena & Brown (2020) identified analytics as a key skill category for BI. Many organizations and companies are still struggling to realize the benefits of Business Analytics to remain competitive in the market (Duan &Xiong, 2015). In support of this, "lack of understanding on how to use analytics to improve the business is the leading obstacle to widespread analytics adoption" (Whitelock, 2018. p.81; Philips-Wren et al., 2015; Alharth, Krotov & Bowman, 2017). BA can be grouped into four segments, namely: descriptive, diagnostic, predictive, and prescriptive analytics. Descriptive analytics aims to find patterns and themes using past events and current data. Gupta et al., (2015) had the same view that BI also serves to extract value by using historical data. Diagnostic analytics uses descriptive data to understand the current situation and provide reasons for such occurrences (Duan & Xiong, 2015). Whitelock (2018) postulates that predictive analytics forecasts future events before they happen. Predictive analytics uses statistical tools such as regression and decision trees to predict events. On the other hand, prescriptive analytics seeks to answer questions such as "What actions need to be taken? (Demirkan, Bess, Spohrer, Rayes, Allen, & Moghaddam, 2015; Whitelock, 2018). Prescriptive analytics acts as an advisory measure to implement in a given situation. Prescriptive analytics uses simulation modelling, heuristics search and mathematical methods (Duan & Xiong, 2015). To better understand BA skills, it is important to interrogate data science skills, Big Data and BDA concepts as they present some similarities in skills and tools used. The emergence of BDA and DS has also brought about the new data scientist role.

2.5.1 Business Analytics Skills
Literature has reported the following skills to be requisite in Business Analytics (*Add value to raw data by applying sophisticated tools, apply technical and business skills synergistically, find patterns and themes using past events and current data, have expertise in statistical tools such as regression and decision trees to predict events, use statistical, quantitative and predictive models to make decisions, and tools such as machine learning, analyze business performance, provide insights, drive recommendations to improve performance, mine and aggregate, raw data through real-time dashboards, problem-solving Skills, SQL Query/Code Writing, research skills, data interpretive ability, data mining, statistical methods training, data modelling and visualization*) (Demirkan et al., 2015; De Jager & Brown 2016; Whitelock, 2018)

2.6 Big Data Analytics (BDA)
Big data is an umbrella term that focuses on techniques used to overcome the challenges of big data sets (Duan & Xiong, 2015; Ram, Zhangb, Koroniosc, 2016). Big data aims to improve organizations by using both structured and unstructured data to predict the future of business operations such as sales and its market (Philips-Wren, 2015). With the constant changes in technologies, employees need to be well-versed with the tools and techniques to apply them to

large data sets (Duan & Xiong, 2015). Furthermore, Whitelock (2018) alludes that one of the major challenges of big data analytics is the lack of skills and insufficient analytics training.

The main challenge in utilizing BDA in organizations cannot solely be attributed to technology but also to individuals with requisite BDA skills and with talent to fully realize its benefits (Grover, Chiang, Liang & Zhang, 2018). The emergence of BDA skills has also brought a new role, namely that of the Data Scientist. There has been much confusion on what requisite skills one ought to have to perform the duties of a Data Scientist. This study will also identify the required skills for BDA professionals to clear up this confusion.

2.6.1 Characteristics of Big Data

Seven dimensions of big data are namely: volume, value, validity, variety, veracity, velocity, and visualization (Figure 3). The volume of data refers to the large amounts of data being collected and stored in different platforms (Sun, Strang &Firmin, 2016; Philips-Wren et al., 2015 & Rahman, Begum, &Ahmed, 2016). Value is described as the usefulness of data collected (Alharth et al., 2016; Whitelock, 2018). Conversely, the value of data should have statistical, hypothetical, correlations, and modeling features (Rahman et al., 2016). Validity refers to how accurate and truthful is the data being provided (Rahman et al., 2016).

Figure 3: Big data 7 'v's (Rahman, Begum, &Ahmed, 2016; Khourdifi, Bahaj, & Elalami, 2018)

Variety of data focuses on the heterogeneity of data, which means different types of data. Data can be structured, semi-structured or unstructured (Gandomi & Haider, 2015; Alharth et al., 2017). Subsequently, veracity aims at quality, authenticity, accountability, and trustworthiness of the data (Singh & Singla, 2015; Gandomi & Haider, 2015; Rahman et al., 2016). Alharth et al., (2017) are also for the idea that the value of data does not depend on its size, but the quality and truthfulness in data. Velocity is based on the speed at which the data is being collected. Finally, visualization refers to both readability and accessibility of data (Khourdifi et al., 2018; Walker & Brown, 2019). The data consists of data collected in real-time or offline or data in motion such as social media

messages (Gandomi & Haider, 2015; Rahman et al., 2016 and Alharth et al., 2017). On the other hand, a continuous increase in technological advancements has also driven the need for human and technical skills because of big data's characteristics (Philips-Wren et al., 2015; Alharth et al., 2017).

2.6.2 Big Data Analytics skills
The major skills that are important for a BDA professional include using *multiple programming languages, using structured and unstructured data to predict the future of business, applying technical skills, performing quantitative data analysis, ability to perform quality data analysis, managing data from different data sources, use multiple technologies, employ data mining skills, managerial skills, problem-solving* (Gandomi & Haider, 2015; Philips-Wren et al., 2015; Alharth et al., 2017).

2.7 Data Science
Data Science (DS) includes a set of principles, problem definitions, algorithms, and processes for extracting useful patterns from data (Kelleher & Tierney, 2018; Kotu & Deshpande, 2018). Kelleher & Tierney (2018) state that DS encompasses collecting, cleaning, and transforming unstructured social media and web data. Big data technologies enable data to be stored and handle large unstructured large datasets and ethical and regulatory issues.

DS is not always done in a vacuum. It is a collaborative attempt that attracts some of the roles, skills, and tools. Sometimes these roles may overlap (Mount & Zumel, 2019). One of the roles in DS is a Data Scientist who is responsible for planning and directing the project; the Data Scientist should be well versed in statistics and machine learning. The next role in DS is Data Architect responsible for data storage, managing data warehouses for various projects, and providing advice when needed (Mount & Zumei, 2019). In a nutshell, "Data science and computational social science are emerging interdisciplinary fields that overlap in content with big data, BI, and analytics" (Miller, 2018, P.53).

2.7.1 Data Science skills
"Data science and computational social science are emerging interdisciplinary fields that overlap in content with big data, BI, and analytics" (Miller, 2018, P.53). Literature has shown these skills to be requisite for Data science: *Work with data in real-time, apply data analysis techniques, make sense of messy data, transform both structured and unstructured data into insights, analyze the data with sophisticated analytical tools and techniques, apply expertise in big data and analytics, apply problem-solving skills, use statistical tools and machine learning, work independently, communicate stories to the business that form the basis for actionable insight into data, use R, and strong statistical skills, design and develop new computational techniques to solve business problems, generate static and dynamic visualizations in a variety of visual media, translate the data-driven insights into decisions and actions* (Mount & Zumel, 2019; Kelleher & Tierney 2018; Mikalef et al., 2017).

2.8 Critical assessment of literature
A lack of clear distinction between BI and BA has raised some questions on whether these two concepts share the same meaning. Bayrak (2015) highlighted some similarities in the usage of BI and BA. However, research has shown that the similarity lies in one element of BA: descriptive analytics. Descriptive analytics is one element of BA that uses current and past data. On the other

hand, BA's three (predictive, prescriptive, and diagnostic analytics) elements are different to BI as they focus on predicting analytics and use sophisticated tools to achieve this. Furthermore, BI is more descriptive in nature, and BA focuses on predictive, prescriptive, and diagnostic analytics. On the other hand, BDA works with big data, focusing on tools to work with big data. Walker & Brown (2019) state that although BDA provides more insights and benefits over BI, the response received from its study showed that BDA could not replace traditional BI systems. Debortoli (2014) concurs with the idea that BDA will not replace traditional BI systems.

Studies on similarities in data analytics and data science have been done. However, they focused more on course descriptions for undergraduate programs and competencies in software development (Gardiner, Aasheim, Rutner, & Williams, 2015; Kim et al., 2016). Many studies used job advertisements as their data source in qualitative research (Gardiner et al., 2018; Ram et al., 2016; Linden et al., 2019). Furthermore, content, and thematic analysis were employed to analyze the data (Pejic, Bach, Bertoncel, Mesko, & Krstic, 2020). However, the studies lack some variety in the methods employed to validate the results, potentially leading to bias in the study.

2.9 Conceptualization of Business Intelligence (BI), Business Analytics (BA), Big Data Analytics (BDA), and Data Science (DS)

The focus of this section is to define BI, BA, BDA, and DS based on the literature review and the direction of this study. Studies have shown that BI, BA, BDA, and DS are somewhat linked. In this study, BI is the application of tools, techniques and systems for decision making, and BA is more on predicting the future of business using predictive analytics; DS uses a combination of statistics, data mining and artificial intelligence to add value to data (Van Der Aalst, 2016). Finally, BDA focuses more on advanced analytical tools for data analytics on large data sets.

BDA discussion without BI and BA will not suffice to understand its role and skills in business and organisations. This study aims to fill the gap on skill requirements for BI, BA, BDA, and DS and identify overlaps and differences, particularly in skills. Various skills have been highlighted to be of utmost importance when dealing with data. Business acumen, data analysis, technical and non-technical skills (Costa & Santos, 2017).

2.10 Conceptual model for BI, BA, BDA, DS

Through integrating ideas generated from the literature review, Figure 4 presents a unified model below. A unified model has been adopted due to its relevance in the phenomena to be discussed. The concepts that have been relevant in this model are BI, BA, BDA, and DS. Derbortoli et al., (2014) developed a framework for Business intelligence and big data skills. The model indicates that understanding an organization's business, management, and IT concepts is required to identify BI, BA, BDA, and DS skills. The organizational context was split into four parts: business knowledge, management knowledge, concepts knowledge, and IT. A unified model would be applicable in this study integrating technical skills, data science skills, and organizational context. The tools highlighted in the unified model are only examples and are not a complete list.
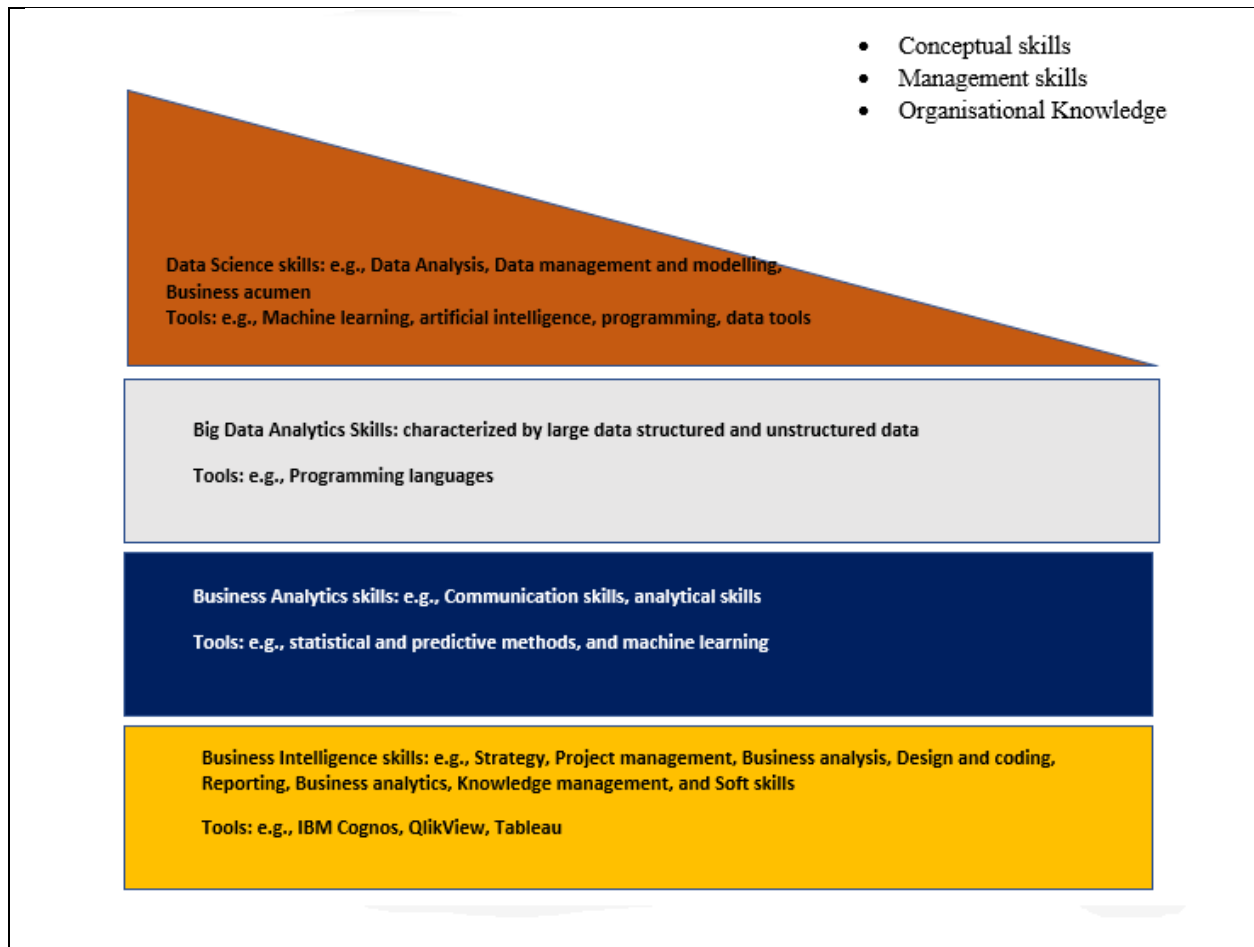
Figure 4: Unified model for BI, BA, BDA, and DS (Derbortoli et al, 2014; Costa & Santos, 2017; Hattingh et al., 2019; Kusena & Brown, 2020)

Due to the multiple concepts being investigated (BI, BA, BDA, and DS), different models discussed the skills partially. The goal of a unified model is to integrate all concepts and investigate them as whole. The unified model describes the skills, knowledge base and tools to be used. Due to the particularities of the BI, BA, BDA, and DS professional skills set, four main classifications were presented (see Fig.4). The three categorizations outside the model (conceptual skills, management skills, and organizational knowledge) were present in all the four domains.

- Organizational context

Business acumen is a requisite when working in the data age as well as knowledge of tools involved to make sense out of data. Hattingh, Marshall, Holmer, & Naidoo, (2019) postulate that four distinct groups of organizational knowledge, namely: contextual knowledge, domain knowledge, management skills and strategic thinking, are vital for Data Scientists. Domain knowledge refers to the expertise required in business. An understanding of the business, for example digital marketing or health care, is a prerequisite to be able to execute all the duties. Managerial skills have also been identified as part of the business context.

- Management skills

Hattingh et al., (2019) argue that data scientists should possess project management, and IT skills. Data scientist role is an offshoot of BDA (Costa & Santos, 2017). Basic understanding of the management of an organization is a requisite for Data Scientists and Data Analysts. Data science skills such as project management are a requisite for Data Scientists. The most common disciplines for Data Scientist are said to be Computer Science, Information Systems, and Statistics (Costa & Santos, 2017; Hattingh et al., 2019).

- Conceptual skills

Conceptual knowledge has been highlighted to be of utmost importance. Concepts and methods pertain in both big data analytics and business intelligence (Derbortoli et al., 2014).

- Technical skills

Knowledge of tools applied to data such as QlikView, machine learning, database administration and statistical tools had been highlighted to be a core requisite for professionals working in BI, BA, BDA, and DS. (Derbortoli et al., 2014; Hattingh, et al., (2019). The ability to design and code using a variety of programming languages is crucial (Demauro et al., 2018; Costa & Santos, 2017). Knowledge in database administration, noSQL databases, quantitative analysis, machine learning, and data warehousing are essential in the data age (Derbortoli et al., 2014; Costa & Santos, 2017; Hattingh et al., 2019). In this context, tools are techniques applied to data, for example, quantitative methods and statistical tools such as regression and decision trees.

2.11 Chapter Summary

While the studies conducted contributed to an understanding of the skills requirements for BI, BA, BDA, and DS (Schoenherr & Speier-Pero, 2015; Mikalef et al., 2017), BI is more descriptive in nature, and BA focuses on predictive, prescriptive, and diagnostic analytics. On the other hand, BDA works with big data, focusing on tools to work with big data. There is a gap on how data science fits into BDA and sub-profiles could also be provided for Data Scientists role. To determine the skills, a multi-method approach was employed to dispel any biases in the results obtained and offset the weaknesses of both qualitative and quantitative methods.

CHAPTER 3: RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction
This section will discuss research philosophy, data collection and analysis methods, sampling methods and research instruments. The research design and methodology will be outlined as follows:

3.2 Research Philosophy
The philosophy for the research was based on pragmatism. The research paradigm chosen influenced the techniques used for data collection, analysis, and choice of research methods (Saunders, Lewis, & Thornhill 2016). For the purpose of this research, multi-methods were employed due to the assumptions that underlie a pragmatism approach. The philosophical underpinnings of pragmatism state that "each person's knowledge is socially shared as it is created from socially shared experiences" (Kaushik & Walsh, 2019). The pragmatist philosophy is suitable for this research. It aims to use experts' knowledge in the BI, BA, BDA, and DS field to understand and identify experiences and skills involved to perform their jobs.

3.3 Research Purpose and Approach to theory
This research was exploratory as it seeks to gain an in-depth understanding of professional skills for BI, BA, BDA, and DS. To this end, it informs about BI, BA, BDA, and DS requisite skills. Exploratory studies are used to discover new ideas, themes and theories on a specific phenomenon (Denscombe, 2017). The approach to this study is inductive as the unified model established through literature review is used only to guide the research process, and from the data gathered a model will be developed.

3.4 Research Strategy
Saunders et al., (2016) state that multi-method research involves more than one data collection and analysis technique to answer research questions. Cegielski & Jones-Farmer, (2016) suggest that use of multiple research methods and techniques reduces the risks of relying on one method. Thus, this study uses a multi-method strategy. A sequential multi-method strategy was employed (Cui, Mou, Cohen, & Liu, 2019), starting with online job advertisement analysis followed by the Delphi method.

Job advertisements allow employees to search for opportunities and recognize skills and responsibilities employers are searching for (Kureková, Beblavỳ, & Thum-Thysen, 2015). Job advertisements are used to collect data on skills. Online job advertisement analysis is a well-established means of analyzing changes in job requirements and current trends.

The Delphi method has been employed widely in research and is gaining popularity in Operations Management, Public Administration, and Information Systems studies (Pare et al., 2013; Keil, Lee, & Deng, 2013). Due to its flexibility, it enables both qualitative and quantitative sources to be used (Brady, 2015). Input from a panel of experts is required. The number of experts used in Delphi studies ranges from 7 to 30 experts (Pare et al., 2013; Weibl & Hess, 2018). Parel et al., (2013) argue that at least 7 members or experts should make a panel. The Delphi method comprises of three phase process: brainstorming, narrowing down, and ranking (Schmidt, 1997). The Delphi process starts by selecting the experts, and the research problem is presented to them. Feedback is

then gathered and put into a list by the researcher. The list is then given back to the panel for ranking. The ranking process continues through multiple rounds until a level of agreement is reached (Keil et al., 2013).

3.5 Sampling strategy

3.5.1 Target population

The target population for job advertisements was online job advertisements for South African positions posted online.

For the Delphi method, the target population was professionals in data driven organizations in South Africa who were experts in BI, BA, DS, and/or the BDA domain.

3.5.2 Sampling

"Sampling is defined as the statistical process of selecting a subset of the population of interest for making observations and statistical inferences about that population" (Bhattacharjee, 2012.p.65). For Job Advertisement analysis, LinkedIn and Indeed online job portals were used due to their professional nature and audience, and their large coverage popularity.

For the Delphi method, purposive sampling, was employed to select individuals that the researcher believed had the answers to the research questions or satisfied the research objectives (Saunders, et al., 2009). The researcher searched for professionals in BI, BA/BDA, and DS using the LinkedIn profiles. The research used LinkedIn.com as it seeks to get insights from the experts with the correct knowledge and experience. Purposive sampling was adopted for this study as it focuses on a small number of people which is best suited for this research. "...getting test information by selecting items or people most likely to have the experience and expertise to provide quality information and valuable insights on the research topic" (Denscombe, 2017, P.35).

South African specialists in the aforementioned fields were sampled for the study. Initial participants were 24 at the beginning of the study, however 21 data professionals remained for the study (7 experts from BI, 7 from BA/BDA and 7 from DS).

3.5.3 Research Instrument

For the Delphi method the research instrument was an online questionnaire which comprised of demographic questions and one question to identify the requisite skills for BI, BA, BDA, and DS (see Appendix 3). The research instrument was distributed to professionals in the aforementioned domains who were contacted via LinkedIn to check if the questionnaire was working as intended.

3.6 Data collection procedure

The data collection process was collected in two parts - using secondary data from two online job advertisements (LinkedIn and Indeed) and for the Delphi method, using online questionnaires which were distributed to professionals in the BI, BA, BDA, and DS sector in South Africa. Due to covid 19 and participants being geographically dispersed, online questionnaires were used.

3.6.1 Job advertisements

One of the popular online platforms used to search for jobs is LinkedIn (Zide, Elman, & Shahani-Denning, 2014). LinkedIn has been used as a source of job advertisements for different reasons. "LinkedIn is a particularly interesting target, given the professional nature of its audience" (Bradbury, 2011.p.5; Sinha & Thaly, 2013). In this research, two online job portals, namely LinkedIn and Indeed were used due to their professional nature and their wide audience coverage. De Mauro et al. (2018) believe that companies depend more on emotional interpretations of their

company needs due to the vague skill description and data analytics roles. Data was collected for the period between February 2021 to May 2021. A total of 482 job adverts were collected, inclusive of BI, BA, BDA, and DS.

The researcher reached a point of saturation where no more new job advertisements were posted and decided to stop collecting data from job advertisements. The final figures for job ads from the two job portals were obtained after data had been refined through the removal of duplicates; content that did not match the criteria of the search were also removed. To better understand the skills requirements, the Delphi method was employed to validate the data collected from online advertisements.

3.6.2 Delphi method

This research used 24 experts in the initial analysis. Of these, 7 experts, from BI, BA/BDA, and DS respectively remained in the final analysis. A questionnaire was sent out via email to BI, BA, DS, and BDA experts. This phase seeks to solicit BI, BA, DS, and BDA skills from experts. The selection process for these professionals was based on their expertise in the aforementioned domains. To meet the selection criteria, demographic information was collected such as educational qualifications, years of experience and role held in the company.

3.7 Data Preparation

For Job Advertisement Analysis, initial analysis was done by recording all the data collected from online portals to Excel spreadsheets. For the Delphi method, data gathered from questionnaires was recorded as it became available, in Excel, with codes attached to each questionnaire to make identification and privacy issues easier to handle.

3.8 Data Analysis

3.8.1 Job advertisement analysis

For Job Advertisement Analysis, data analysis was done in two parts. First, data were analyzed using descriptive analysis and the second stage data was analyzed using thematic analysis. In the descriptive analysis data was classified and categorized in terms of job location, skills, job portal, experience, qualifications and certifications, BI, BA, DS, and BDA jobs industry offering, and online job portals used. The use of word cloud and bar charts were used for data presentation and analysis.

Thematic analysis was employed in identifying and analyzing patterns of skills. The six phases of thematic analysis were followed. The six stages are: familiarizing your with data, generating initial codes, searching for themes, reviewing themes, defining, and naming themes, and producing the report (Braun & Clarke, 2006).

3.8.2 Delphi Method Data Analysis

For Delphi method, data was recorded in an Excel spreadsheet as it became available. Skills were recorded to create a list from all experts for each domain (BI, BA/BA, and DS). In the Delphi method, data was analyzed in stages. Thematic analysis was the method used in this study to examine online questionnaires, and to categorize skills. The entire data had to go through a thorough review process as part of the thematic approach in order to find, analyze, and report patterns (themes) that emerged from the data (Braun & Clarke, 2006). This study used the theme analysis method described by Braun and Clarke (2006).

3.9 Ethics and Confidentiality
Ethics was considered before data collection commenced. Confidentiality was ensured, and withdrawal of participants was allowed at any stage of the process. Data collected was used for research purposes only. In addition, the names of organizations involved in this research were kept anonymous. Furthermore, ethical letters addressing participants and organizations about privacy and confidentiality were issued. Ethics approval was granted by the Department of Information Systems before data was collected.

3.10 Resources and Plan
This research did not require many resources since it was conducted in Cape Town, South Africa. Questionnaires were sent via electronic mails which made it easier for the researcher to reduce costs of travelling and to accommodate Covid-19 restrictions. Furthermore, participants for this study were geographically dispersed. Minimal financial resources were required for telephonic and data costs to contact the experts involved in the research.

CHAPTER 4: DATA ANALYSIS AND FINDINGS

This chapter describes the research report on findings and analysis of data such as themes emerged in relation to the literature review. The rest of the chapter is presented as follows: Job advertisements analysis, Delphi method analysis, and discussion of findings.

4.1 Job Advertisement Analysis

Table 2 tabulates job portals used for data collection. The choice of the two job portals was influenced by their semi- structured nature, and employers' information was widely published on indeed and LinkedIn (Pejic-Bach et al., 2020; Verma, 2019; Gao & Eldink, 2014).

Table 2: Online Job portals

	Online job portals			
	BI	**BA**	**BDA**	**DS**
Indeed	99	40	27	102
LinkedIn	104	21	5	84
Total	**203**	**61**	**32**	**186**

4.1.1 Online job advertisements Descriptive analysis

In the descriptive analysis phase, data was classified and categorized in terms of job location, job portals, roles, experience, skills, qualifications, and certifications.

4.1.1.1 Online Job location

Data was collected from all different provinces in South Africa. Table 3 shows the location of advertised jobs. Out of the nine provinces in South Africa, seven of the provinces had BI jobs (see Table 3). Data science as the next in line with BI, had six provinces represented. Business analytics and Big Data Analytics had the least number of provinces represented in their respective domains. Overall, Gauteng had the greatest number of jobs being offered for BI, BDA, and DS.

Table 3: Online Job location

	BI	BA	BDA	DS
Eastern Cape	2		1	6
Free State	2			1
Gauteng	103	21	16	91
Kwazulu-Natal	6	3	1	8
Limpopo	4			1
Mpumalanga	1			
Western Cape	81	33	13	73
Not specified	4	4	1	6
Total	**203**	**61**	**32**	**186**

4.1.1.2 Online Job Roles

Roles that were advertised for BI, BA, BDA, and DS had some commonalities in them and others were different in other domains. Architect roles were common in BI, BDA, and DS (see Table 4). Data Analysts, Data Architects, and Data Engineers were common in BA, BDA, and DS and not in BI. Some job titles were in common with BA &DS (Team lead and Consultants), and BDA &DS (Product manager). Machine learning engineer is only present in DS.

Table 4: Online Job roles

	BI	BA	BDA	DS
Ads				
Business Analyst	✓	✓		
Architect	✓		✓	✓
Consultant	✓			✓
Developer	✓			
Specialist	✓		✓	
Team Lead	✓			✓
Manager		✓		
Data Analyst		✓	✓	✓
Data Architect		✓	✓	✓
Data Engineer		✓	✓	✓
BDA Administrator			✓	
Data Scientist			✓	✓
Product manager			✓	
Machine Learning Engineer				✓

4.1.1.3 Programming languages required

Programming languages were emphasized to be important across all the domains, as shown in Figure 5- Figure 8. SQL, Python and R are predominant in all the domains, However BDA requires programming languages in several languages such as Java, NoSQL, and Scala. In addition, BDA and DS have a big proportion of SQL, Python, and Java as a programming language requirement.
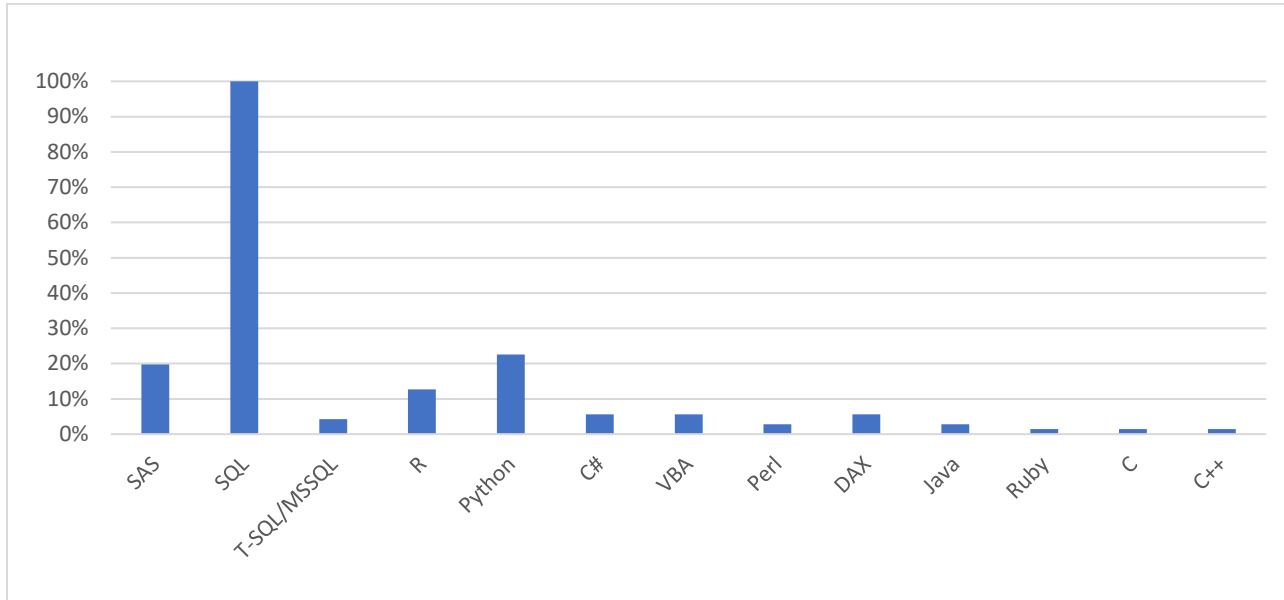
Figure 5: BI Programming languages

In BI, findings have shown that SQL and Python, and SAS are the requisite programming languages. BI professionals require very little knowledge on C, C++ programming languages as depicted on Fig.5. It is evident that to be able to work efficiently in the BI field, strong knowledge and skills in SQL, SAS, and Python is a requisite.
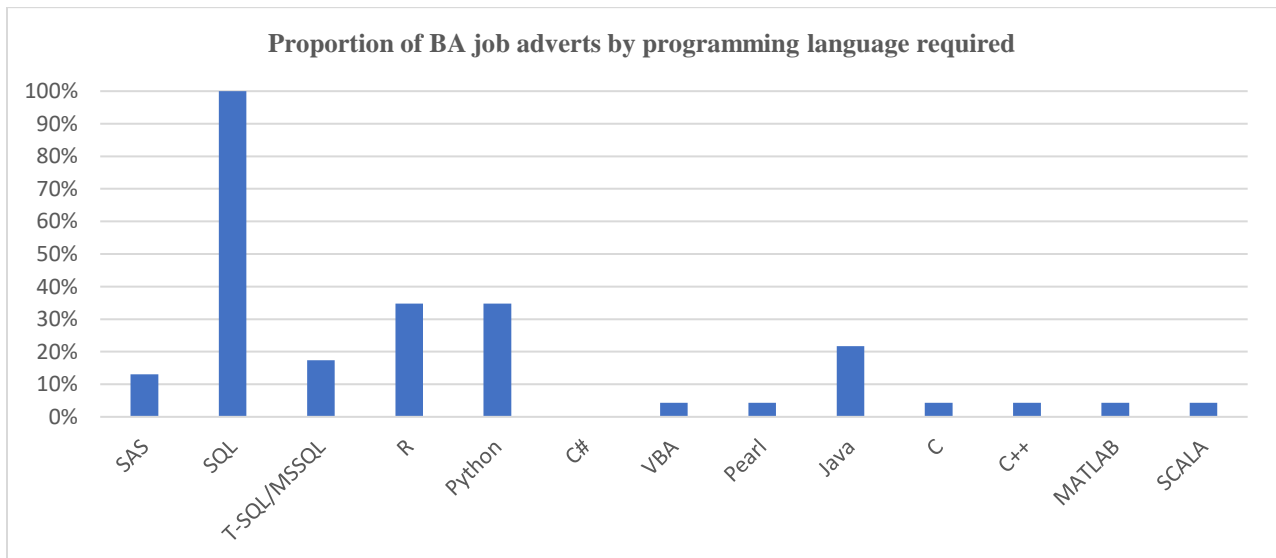
Figure 6: BA programming languages

Professionals in BA require programming skills in SQL, Python, R, Java, and SAS. An interesting trend is evident between BI, and BA. Programming language in SQL, and Python as a requisite skill. In addition, Java and R are shown to be addition languages as compared to when working in the BA domain.
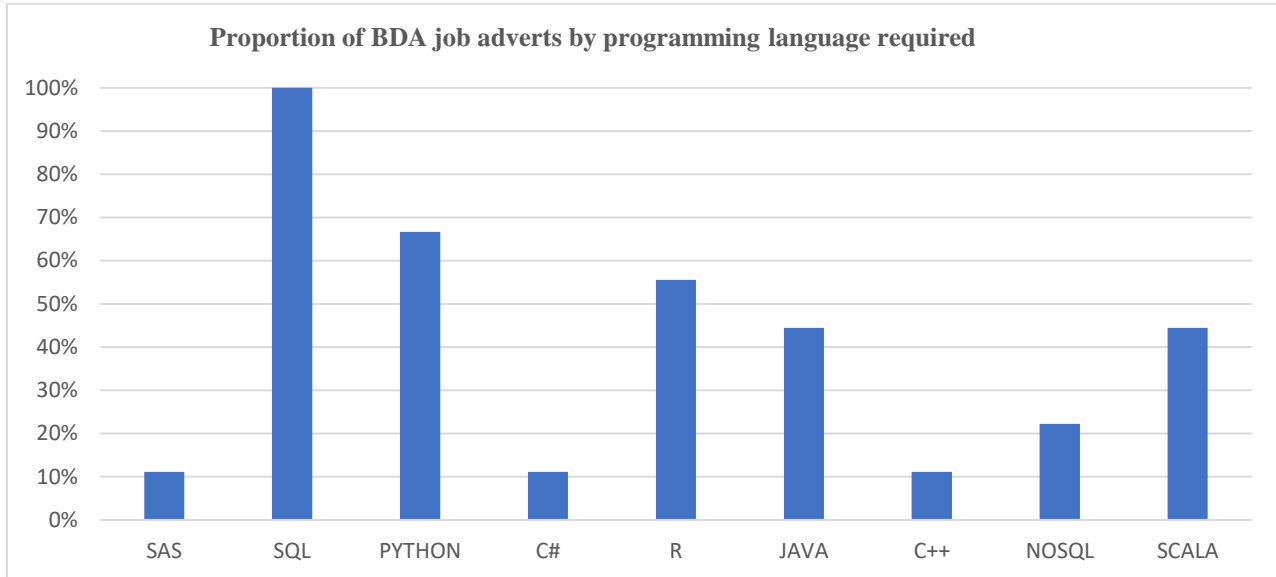
Figure 7: BDA programming languages

BDA professionals require SQL, Python, R, Java, Scala, NoSQL, and SAS as the preferred programming languages. SQL and Python have shown to be prominent programming languages in both BA and BDA. Fig. 7 indicates that BDA requires a plethora of programming skills to be able to work efficiently and effectively.
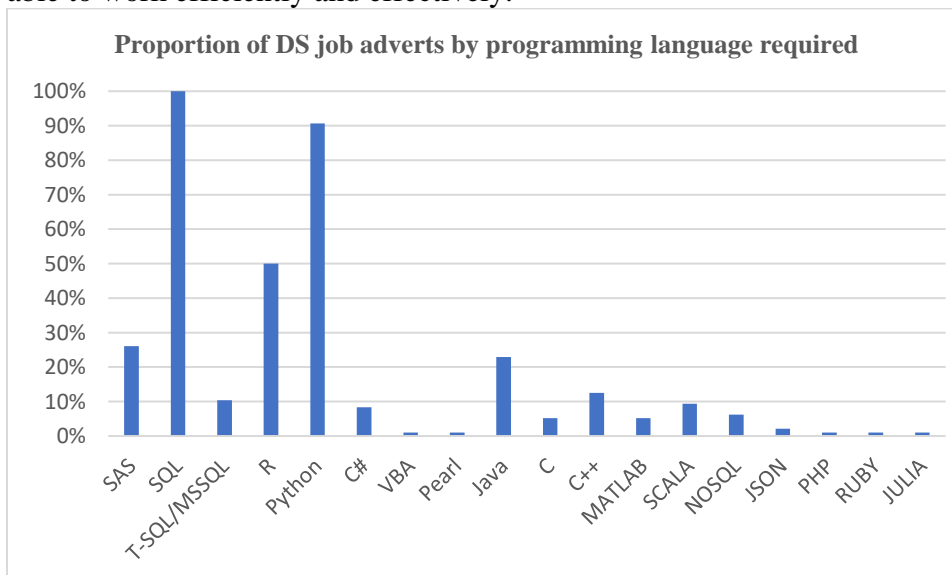
Figure 8: DS programming languages

SQL, Python, R, and Java are the most preferred skills in DS. There is a similar pattern of programming skills between BDA and DS. It can be said that an individual working in the BDA sector might be able to work in DS sector as they use the same programming languages.

4.1.1.4 Years of Experience

BI, BA, BDA, and DS jobs that were advertised required some level of experience in those domains. Figure 9 illustrates the requisite years of experience for BI, BA, BDA, and DS professionals in South Africa. The requisite years were grouped into a range of four groups. The most required experience for BI, BA, BDA, and DS ranged from "0-3 years", "4-6 years", "0-6 years", and "4-6 years" respectively.
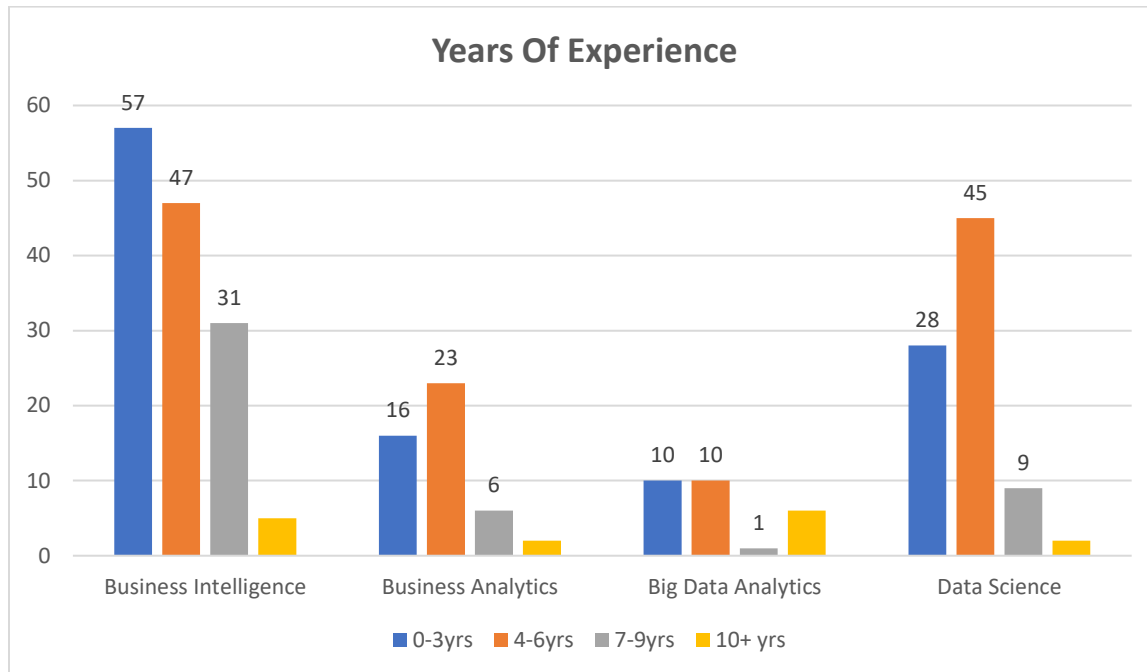
Figure 9: Requisite years of experience for BI, BA, BDA, and DS professionals

4.1.1.5 Requisite qualifications

As shown in Figure 10, four-word clouds represent the preferred qualifications for the BI, BA, BDA, and DS fields; 55%, 67%, 69%, and 80% respectively indicated a preference for a degree, and Computer Science, Information Systems, Mathematics, Statistics, and Engineering stood out as the most desired specialization. Skills that were identified from job advertisements were used to inform in the next stage of the data collection process.
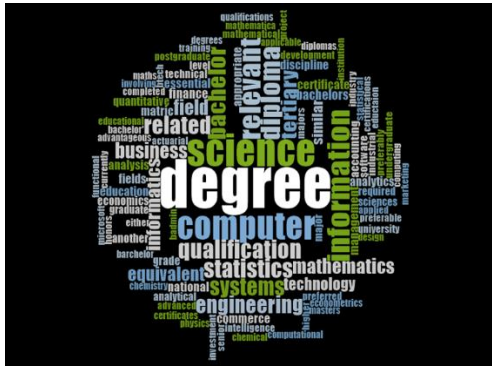
BI

BA
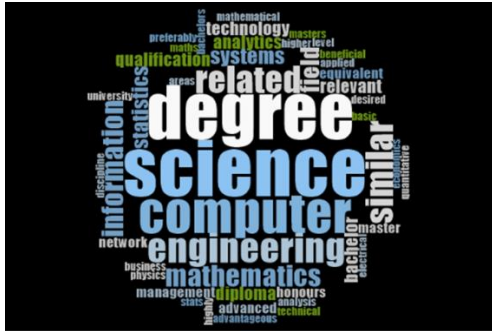
BDA
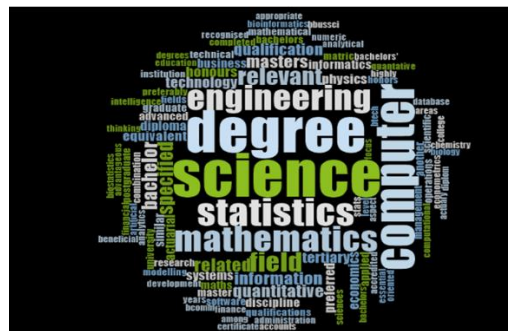
DS

Figure 10: Word clouds for requisite qualifications for BI, BA, BDA, and DS

4.1.2 Qualitative analysis – Job Advertisements Analysis

A thematic analysis was adopted for analysis of online job advertisements skills (BI, BA, BDA, DS), and literature. The researcher followed steps for thematic analysis (Braun & Clarke, 2006). The steps for thematic analysis are explained in detail and how the researcher applied them.
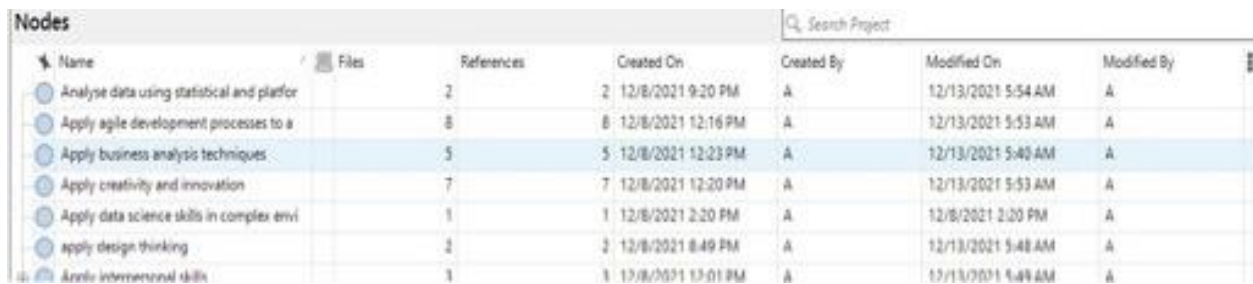
- **Familiarization with data**

  The skills were initially collected from literature review, followed by online job advertisements. The data was organized by the researcher on an excel spreadsheet in preparation for analysis. NVivo software was used to analyze the skills and find patterns and themes within the text. The researcher re-read the data to get a better understanding and familiarization of data before the initial analysis commenced.

- **Coding the data**

  The imported data was coded using NVivo software which is a Computer Aided Qualitative Data Analysis Software (CAQDAS). Having familiarized with the data, the codes were generated using nodes. The process of generating codes were conducted by providing actual examples and showing how codes were determined. For example, extracts from job advertisements clearly indicated that analytics is a requisite in BI. *"...use reporting tools", "Able to use BI tools", "...QlikView for Data modeling and Report building"*. The above statements indicated that knowledge and ability to use BI tools and develop reports are important skills, thus two codes were generated and named *Reporting tools, and Able to use BI tools.*

  Another example from the job advertisements, and literature was on *"...System and Data Analytics", "Insights Driven Data & Analytics strategy development", "SAP Analytics", "Data Analytics".* Skills obtained from another advert stated that "*Knowledge of automation & analytics tools".* The idea that was brought forward was of Analytics, hence two codes were created and named, *Apply data analytics techniques, and Use automation and analytics tools.* Figure 11 shows the initial codes in NVivo.

Nodes							
Name	Files	References	Created On	Created By	Modified On	Modified By	
Analyse data using statistical and platfor	2	2	12/8/2021 9:20 PM	A	12/13/2021 5:54 AM	A	
Apply agile development processes to a	8	8	12/8/2021 12:16 PM	A	12/13/2021 5:53 AM	A	
Apply business analysis techniques	5	5	12/8/2021 12:23 PM	A	12/13/2021 5:40 AM	A	
Apply creativity and innovation	7	7	12/8/2021 12:20 PM	A	12/13/2021 5:53 AM	A	
Apply data science skills in complex envi	1	1	12/8/2021 2:20 PM	A	12/8/2021 2:20 PM	A	
apply design thinking	2	2	12/8/2021 8:49 PM	A	12/13/2021 5:48 AM	A	
Apply interpersonal skills	1	1	12/8/2021 12:01 PM	A	12/13/2021 5:49 AM	A	

Figure 11: Coded data

- **Searching for themes**

Having created codes, a thorough investigation was conducted to check whether there were no codes that described the same idea. To do this, codes that described the same idea were grouped together to form one distinct theme. For example, initial themes *"Able to analyze numerical data", "...strong analytical skills ", "...Apply data analytics techniques"* were carefully reviewed, and the researcher noted skills on the ability to use analytics and knowledge of statistics, thus the initial codes were grouped together to describe all the themes and were named "Analyze data using statistical and platform analytics tools.

Likewise, initial themes *"...use reporting tools", "Able to use BI tools"* were also reviewed, themes grouped and provided with one name that encompassed all the skills. The initial themes were given one theme called *Use BI/ reporting tools (e.g., QlikView, Tableau, Apex) as* shown in Table 5.

Table 5: Initial themes

Initial Theme	Data extracts (raw data)
Use reporting tools	"You need experience with BI tools, can be power BI Qlik or tableau", "QlikView",
Able to use BI tools	"Use modern BI tools such as BI Cloud Platforms", "Technical experience in either APEX, Tableau or PowerBI desirable", "Proficiency with Tableau Software", "Knowledge of QlikView, machine learning"
Apply data analytics techniques	"System and Data Analytics", "Insights Driven Data & Analytics strategy development", "SAP Analytics", "Data Analytics", " SAP Analytics
Use automation and analytics tools	"Knowledge of automation & analytics tools"
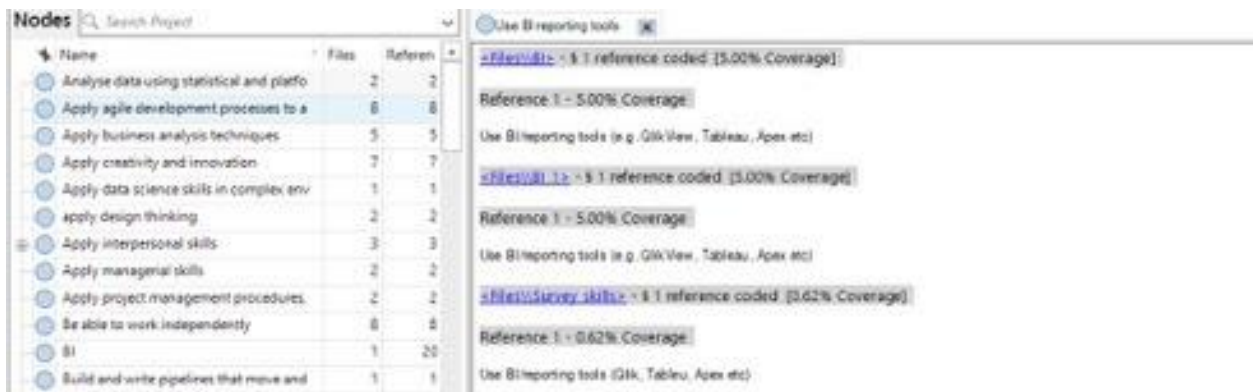
Figure 12: Searching for themes

- **Reviewing themes**

Reviewing themes enables the researcher to refine the themes in areas that need to be improved. To ensure distinctness, and uniqueness in codes, the researcher reviewed some codes by grouping themes that explained the same idea and re-wording the themes without altering the meaning of the data (Table 6).

Table 6: Reviewing themes

Theme	Sub theme	Data Extract
Use BI/reporting tools (e.g., QlikView, Tableau, Apex)	Reporting tools	"…use reporting tools", "Able to use BI tools" …You need experience with BI tools, can be power BI Qlik or tableau ", "…QlikView for Data modelling and Report building".
	Able to use BI tools	"Use modern BI tools such as BI Cloud Platforms", "Technical experience in either APEX, Tableau or PowerBI desirable", "Proficiency with Tableau Software", "Knowledge of QlikView, machine learning"
Apply data using statistical and platform analytics tools	Apply data analytics techniques	"System and Data Analytics", "Insights Driven Data & Analytics strategy development", "SAP Analytics", "Data Analytics", " SAP Analytics
	Use automation and analytics tools	"Knowledge of automation & analytics tools"

- **Defining and naming themes**

The last step of thematic analysis is to define and name themes for the final write up. The researcher thoroughly reviewed all the codes and the themes to check for validity and consistency in data. The full set of skills is found in Appendix 14.

Categorization

A total of 64 skills were found for BI, BA, BDA, and DS. These skills were then categorized into similar groups and labelled by considering categorizations adapted from Keil et al., (2013); Kusena & Brown, (2020) and Zong, Xia, Zhao, Tong, Li, Zhao, & Ren, (2020). The key categories, their definition, and the number of skills each are shown in Table 7 below, with details in Appendix 14.

Table 7: Skills categorization for BI, BA, BDA, and DS

Skill category	Description	Skills
Analytics	"Skills that enable an individual to perform data mining techniques, text mining, and statistical analysis for effective decision-making in an organization" (Kusena & Brown, 2020.p.3)	• Apply forecasting techniques • Apply Ensemble learning like Boosting/Bagging, Neural Networks • Employ data mining skills • Analyse data using statistical and platform analytics tools
Business Analysis	"Business Analysis skills can be the same as Systems Analysis. Skills required are to understand business processes, then identify and elicit business and user requirements" (Kusena & Brown, 2020.p.3)	• Evaluate and improve existing BI systems • collaborate with teams to integrate systems • Define solutions for user facing websites and systems • Employ use cases • Define solutions for user facing websites and systems • Build relationships with existing and potential internal customers to understand their individual requirements and demonstrate how products can add value to their business • Work with software developers and solution designers to deliver analytics-driven solutions • Elicit and document business and user requirements • Apply Business Analysis techniques
Data manipulation and processing	Data manipulation is the process of organizing data to make it easier for readability (Zong et al., (2020).	• Work with data profiling • Stream data • Use Big data technologies and tools • Manipulate data using SQL • Transform data from different sources and load it to extract insights (ETL)

Design and code	"Skills that apply design principles to the development…" (Kusena & Brown, 2020.p.3)	- Review new and existing code to identify areas for improvement - Ability to interpret code and support applications - Code reviews - Apply Design thinking - Carry out BI scripting and end-user design - Use Object-oriented design, data structures and algorithms - Apply Technical and strategic mindfulness to be able to develop and implement new BI systems and processes - Use Data science tools/packages (Python, R, XGBoost, TensorFlow, NLTK) - Work with security design principles - Perform Financial modelling and analysis - Implement and enforce an effective testing strategy with the relevant accompanying processes - Perform data modelling (SQL) - Code in a variety of programming languages (C, C++, C#, Python, Java,and R) - Build real time systems that integrate with the rest of the stack - Build and write pipelines that move and transform data - Design, develop and maintain business intelligence solutions

28

Knowledge management	"Knowledge management is a process of identifying, transferring and applying knowledge at a lower cost" (Kusena & Brown, 2020.p.4)	• Research and provide alternative approaches to supervisory tools for effective risk management • Provide training and coaching
Project management	skills that are related to working on project planning execution (Keil et al, 2013; Kusena & Brown, 2020)	• Apply Project management procedures, tools, techniques etc.
Reporting	"Reporting enables to discover patterns through data extraction and reporting" (Kusena & Brown, 2020.p.3)	• Extract insights and trends from data • Use BI/reporting tools (Qlik, Tableu, Apex etc) • Create visualizations and Dashboards for reporting
Soft skills	Soft skills include the ability to communicate effectively, teamwork, interpersonal skills and problem solving" (Kusena & Brown, 2020.p.4)	• Apply creativity and innovation • Creative thinking • Ability to effectively deal with conflict situations and Emotional intelligence • Collaborate within multi-disciplinary teams to integrate systems • Exhibit Time management skills • Demonstrate a high level of trust and self-discipline • Adapt to rapidly evolving priorities in a highly technical and fast-paced environment • Handle clients professionally during all interactions • Apply interpersonal skills • Be able to work independently • Communicate effectively, verbally and in writing • Demonstrate problem-solving skills

Strategy	"Develop a strategic roadmap for an organisation for the long-term goals" (Kusena & Brown, 2020.p.3)	• Define the data technology roadmap as part of a cross functional team
Technical	Technical skills refer to skills that are normally associated with IT Like developers (Keil et al., 2013)	• Comprehend the IT landscape to ensure that solutions designed are not in conflict with the IT architecture • Perform capability mapping in the context of Business Architecture • Apply Artificial Intelligence (AI) • Use version-control systems • Employ Digital Experience Monitoring or end-user experience driven functions • Perform Robotics Process Automation (RPA) • Make development changes and understand system architecture • Use Cloud technologies (e.g create data feeds from on-premises to AWS cloud) • Ensure product quality is built in before product is released • Apply data science skills in complex environments to support customer facing and/or corporate processes • Configure and use a variety of enterprise and productivity tools

Comparative Analysis

It was noticed that there were overlaps between BI, and BA/BDA. Hence a comparative analysis was executed in which 15 skills were common. The skills overlap was as follows: *Transform data from different sources and load it to extract insights (ETL), perform data modelling (SQL), Communicate effectively, verbally and in writing, exhibit time management skills, ensure correct data and error handling, prioritize workload and work well under pressure, extract insights and trends from data, demonstrate problem solving skills, formulate validation strategies and methods to ensure accurate and reliable data, apply agile development processes to achieve outstanding data solutions, Be able to work independently, apply creativity and innovation, manipulate data using SQL, perform data analysis and validation, demonstrate excellent analytical skills*. Refer to Appendix 15.

In addition, a comparative analysis for BI and DS was conducted to establish the overlaps in skills. The following 16 skills overlaps were noted: *Transform data from different sources and load it to extract insights (ETL), perform data modelling (SQL), Communicate effectively, verbally and in writing, Create visualizations and dashboards for reporting, exhibit time management skills, ensure correct data and error handling, prioritize workload and work well under pressure, extract insights and trends from data, demonstrate problem solving skills, formulate validation strategies and methods to ensure accurate and reliable data, apply agile development processes to achieve outstanding data solutions, Be able to work independently, apply creativity and innovation, manipulate data using SQL, perform data analysis and validation, demonstrate excellent analytical skills.* Refer to Appendix 16.

4.2 Summary of Job Advertisement analysis

Initial requisite skills were obtained from online job advertisements within the four categories (BI, BA, BDA, and DS). A summary of common skills categories is shown in the Venn diagram (Figure 13). For detailed individual skills refer to Appendix 14. Findings have shown ten skills categories from job advertisements namely Analytics, Business Analysis, Data manipulation and Processing Design and Code, Knowledge management, Project management, Reporting, Soft skills, Strategy, and Technical.
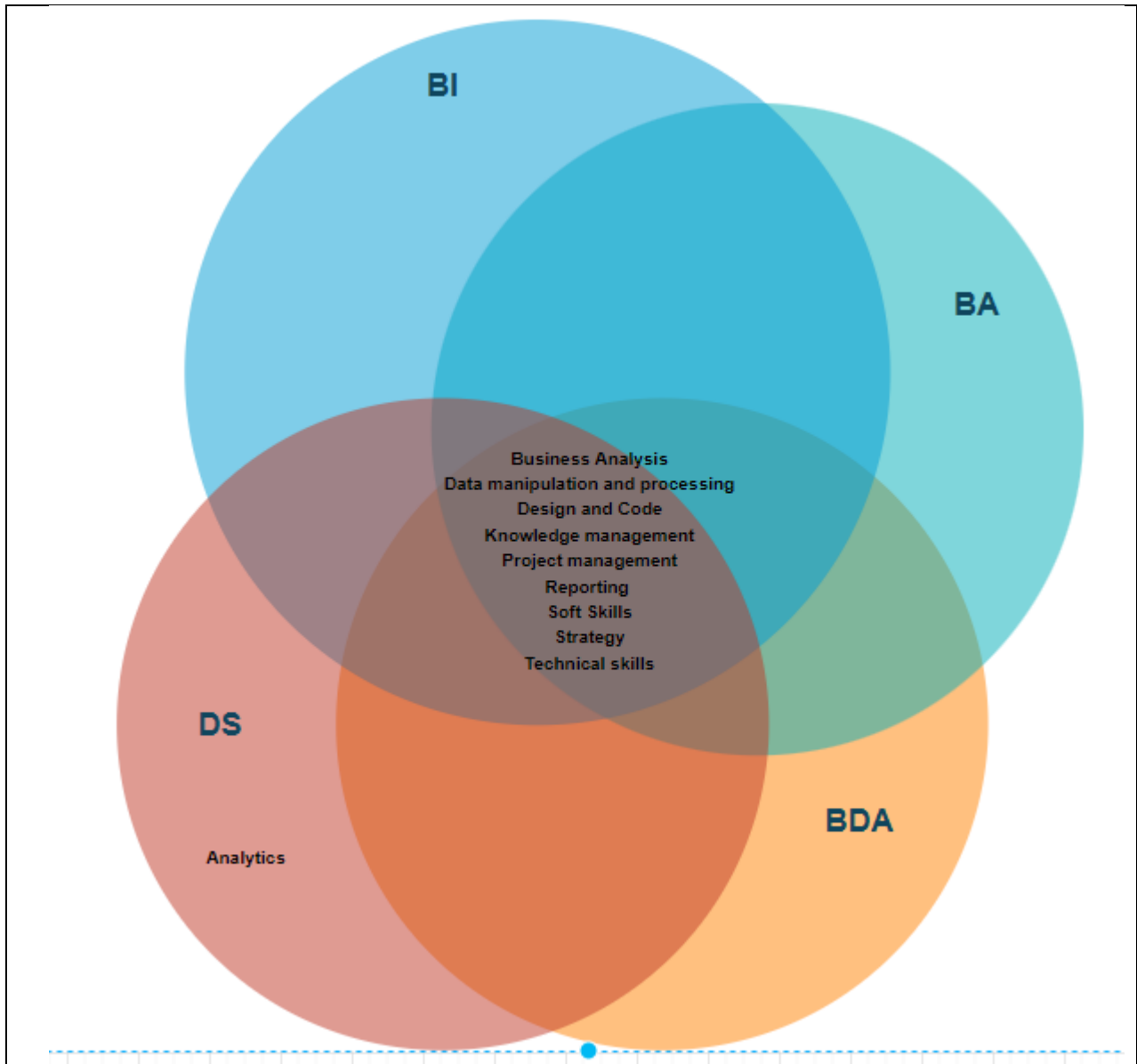
Figure 13: Summary of job advertisements analysis

4.3 Delphi method (data collection and analysis)
Data collection and analysis that followed the Delphi approach comprised of three major phases. The data collection process adopted the steps and phases applied by Keil et al., (2013). Online surveys were used as a data collection instrument. Surveys were distributed via emails for ease of communication. The phases in the Delphi method will be discussed in detail and how they were applied in the next section.

4.3.1 Phase 1: Brainstorming
Brainstorming stage comprises of five major processes which include demographic information of individual experts, solicitation of most important skills from experts, online job advertisements,

and literature review, removal of duplicates, items that describes more than one thing were removed.

4.3.1.1 Selection of Individual Experts

Identification of BI, BA, BDA, and DS professionals was done through browsing LinkedIn profiles and check if they match the required professionals. The researcher contacted the professionals which matched the search criteria to be part of the data collection process. Demographic information of individual experts was collected at an initial stage to check if experts possess the requisite expertise. The selection process for these professionals was based on their expertise in their respective domains (BI, BA, BDA, and DS). To meet the selection criteria, demographic information was collected (Table 8) as follows:

Table 8: Experts' demographic information

[1] "Three of the respondents withdrew from the study before completing other phases"

Experts	Category	Job role	Educational qualification	Experience(years)
1	BI	Business intelligence and Data Analyst	BSc Information Security	4-7
2	BA	Analytics Engineer	BSc Actuarial Science and Financial mathematics	7
3	BDA	Data Engineer	MSc Electrical and Communications Engineering	5-15
4	BI	Head of Business Intelligence	BCom (Hons) Accounting	8
5	DS	Data Scientist	MSc Mathematics and Statistics	2
6	BDA	Big Data Developer	BSc (Hons) Computer Science	
7	BI	BI Analyst	MSc in Economics	2
8	BI	BI Consultant	BSc in IT	7
9	BDA	Big Data Engineer	BSc (Hons) Computer Science	2

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[1]

10	BI	BI Developer	BCom Management Information Systems	12
11	BDA	Big Data Specialist	BSc Computer Science	5+
12	BA	Data Analyst	BSc in IT	5
13	DS	Data Scientist	M.P.H Epidemiology and Biostats	5
14	DS	Data Architect	BCom Information Systems	8
15	DS	Statistician	MPhil Demography	10
16	DS	Data Scientist	BSc Engineering	3
17	BI	BI Developer	BSc in mathematics and Computer science	3
18	BI	BI Consultant	Bachelors	4
19	BA	Senior specialists Insights and Analytics	BSc Applied Mathematics	4
20	DS	Data Scientist	BSc Physics and Mathematics	4-5
21	DS	Data Scientist	MPhil Demography	3
22	BI	BI Analyst	Bachelors	3
23	DS	Data Scientist	Masters in Statistics	2
24	BI	Group Business intelligence and Data Analyst	Bachelors	4

4.3.1.2 Selection of the most requisite skills for BI, BA/BDA, and DS
In this phase, skills were identified from existing literature, online job advertisements skills and from individual experts using online questionnaire designed from Qualtrics. An online survey was used to collect skills from individual experts. Experts were asked to provide at least twenty skills (Pejic et al., 2020).

4.3.1.3 Consolidation and organization of skills
In this phase, a total of 529 skills were generated from all domains (BI, BA, BDA, and DS). The total number of skills included skills from literature review, online job advertisements, and

surveys. Duplicate items and items describing more than one skill were refined. The next step was to organize and clean the data to progress to the next phase of the Delphi method. Responses from surveys were exported to a Word document from Qualtrics, skills from literature review and online job advertisements were also recorded in a Word document.

4.3.1.4 Phase 1 Results
A total of 77 skills remained for further analysis. Skills were categorized under different skills categorizations and descriptions of skills were provided in Table 9 below.

Table 9: A synopsis of BI, BA/BDA, and DS

Skill category	Description	Skills
Analytics	"Skills that enable an individual to perform data mining techniques, text mining, and statistical analysis for effective decision-making in an organization" (Kusena & Brown, 2020.p.3)	- Apply data using statistical and platform analytical tools - Employ data mining skills - Apply Ensemble learning like Boosting/Bagging, Neural Networks - Apply forecasting techniques

Business Analysis	"Business Analysis skills can be the same as Systems Analysis. Skills required are to understand business processes, then identify and elicit business and user requirements" (Kusena & Brown, 2020.p.3)	• Elicit and document business and user requirements • Apply Business Analysis techniques • Evaluate and improve existing BI systems • Employ use cases • Work with software developers and solution designers to deliver analytics-driven solutions • Define solutions for user facing websites and systems • Build relationships with existing and potential internal customers to understand their individual requirements and demonstrate how products can add value to their business
Data Manipulation and processing	Data manipulation is the process of organizing data and make it easier for readability (Zong, Xia, Zhao, Tong, Li, Zhao, & Ren, (2020).	• Provide quick and efficient solutions to data sourcing issues • Stream data • Formulate validation strategies and methods to ensure accurate and reliable data • Manipulate data using SQL • Work with data profiling • Transform data from different sources and load it to extract insights (ETL) • Use Big data concepts, technologies, and tools • Ensure correct Data and Error handling

| Design and Code | "Skills that apply design principles to the development…" (Kusena & Brown, 2020.p.3) | Perform data modelling (SQL) Work with Databases including database design and developments (SQL server 2016) Code in a variety of programming languages (C, C++, C#, Python, Java, and R) Review new and existing code to identify areas for improvement Design, develop and maintain business intelligence solutions Develop data models to inform response programming Perform Financial modelling and analysis Write software that scales horizontally across commodity hardware Apply Design thinking Work with security design principles Carry out BI scripting and end-user design Use Object-oriented design, data structures and algorithms Build and write pipelines that move and transform data Implement and enforce an effective testing strategy with the relevant accompanying processes Apply Technical and strategic mindfulness to be able to develop and implement new BI systems and processes |

		• Use Data science tools/packages (Python, R, XGBoost, TensorFlow, NLTK) • Build real time systems that integrate with the rest of the stack • Make development changes and understand system architecture • Apply data science skills in complex environments to support customer facing and/or corporate processes
Knowledge management	"Knowledge management is a process of identifying, transferring and applying knowledge at a lower cost" (Kusena & Brown, 2020.p.4)	• Provide training and coaching • Stay abreast with the latest developments in the intelligence world. i.e., software and advancements. • Keep informed with respect to latest data protection acts of the global economies to serve data in a safe manner • Research and provide alternative approaches to supervisory tools for effective risk management
Project management	skills that are related to working on project planning execution (Keil et al, 2013; Kusena & Brown,2020)	• Apply Project management procedures, tools, techniques etc.
Reporting	"Reporting enables to discover patterns through data extraction and reporting" (Kusena & Brown, 2020.p.3)	• Use BI/reporting tools (Qlik, Tableau, Apex etc) • Create visualizations and Dashboards for reporting • Develop BI Reports from single and multiple systems • Extract insights and trends from data

| Soft skills | "Soft skills include the ability to communicate effectively, teamwork, interpersonal skills and problem solving" (Kusena & Brown, 2020.p.4) | • Communicate effectively, verbally and in writing
• Demonstrate problem-solving skills
• Demonstrate excellent analytical skills
• Apply interpersonal skills
• Be able to work independently
• Apply creativity and innovation
• Deal with conflict situations and exhibit Emotional intelligence
• Collaborate within multi-disciplinary teams to integrate systems
• Apply creativity and innovation
• Exhibit Time management skills
• Manage and cultivate strong client partnerships
• Apply managerial skills
• Prioritize workload and work well under pressure
• Demonstrate a high level of trust and self-discipline
• Adapt to rapidly evolving priorities in a highly technical and fast-paced environment
• Handle clients professionally during all interactions |
| Strategy | "Develop a strategic roadmap for an organisation for the long-term goals" (Kusena & Brown, 2020.p.3) | • Develop a strategic roadmap for an organisation for the long-term goals
• Define the data technology roadmap as part of a cross functional team |

Technical	Technical skills refer to skills that are normally associated with IT Like developers (Keil et al., 2013)	- Use Cloud technologies (e.g., create data feeds from on-premises to AWS cloud) - Perform root cause analysis - Configure and use a variety of enterprise and productivity tools - Determine appropriate technology solutions for the businesses - Apply technical expertise and research - Ensure product quality is built in before product is released - Comprehend the IT landscape to ensure that solutions designed are not in conflict with the IT architecture - Apply agile development processes to achieve outstanding data solutions - Perform capability mapping in the context of Business Architecture - Carry out Architecture changes, infrastructure, and implementation of new components - Apply Artificial Intelligence (AI) - Use version-control systems - Employ Digital Experience Monitoring or end-user experience driven functions - Perform Robotics Process Automation (RPA)

4.3.2 Phase 2: Narrowing down of BI, BA, BDA, and DS skills

Following Keil et al. (2013), a randomized list of the 77 skills selected from the brainstorming phase round were sent to each individual expert in the four respective domains (BI, BA, BDA, DS) for further selection. The initial number of respondents were 24 but three of the respondents withdrew from the study before phase 2 of the Delphi method commenced

The main purpose of the second phase was to narrow down the list of 77 skills into a manageable number for the ranking phase. Each individual expert was asked to select twenty skills that they considered to be most requisite for BI, BA, BDA, DS respectively. As suggested by Schmidt (1997), skills that were selected by over half of the experts remained for the ranking phase. The initial 77 skills were reduced to 37 skills.

4.3.2.1 Phase 2 Results

Table 10 shows the process of how the 37 skills remained for further analysis. Respondents were given a total of 77 skills to choose from. Participants were asked to choose only 20 skills they considered to be most important. After the selection process, skills that were chosen by more than half of the respondents remained for the ranking process. For example, in Table 10 below, BI had 9 participants and only a count of 5 up to 9 remained for the next phase. In addition, BA had only 3 respondents and a count of 2 to 3 remained. BDA had 4 participants and only a count of 2 up to 3 was considered. Finally, DS had 8 participants in this round and a count 4 to 8 was considered. The top selection per group can be clearly seen in the table below.

Table 10: Top selection skills per group (*BI, BA/BDA, DS)*

Skill	Count (*number of respondents*)			
	BI (n=9)	**BA (n=3)**	**BDA (n=4)**	**DS (n=8)**
Use BI/reporting tools (e.g., QlikView, Tableau, Apex etc)	9	2		
Manipulate data using SQL	7	3	2	6
Perform data analysis and validation	8	2	2	5
Transform data from different sources and load it to extract insights (ETL)	7	3	2	6
Create visualizations and Dashboards for reporting	7	2	2	
Perform data modelling (SQL)	7	3	2	4
Use big data concepts, technologies, and tools			3	
Use Cloud technologies (e.g., create data feeds from on-premises to AWS Cloud)			2	
Analyse data using statistical and platform analytics tools		2		
Communicate effectively, verbally and in writing	5			5
Demonstrate problem-solving skills			2	6
Demonstrate excellent analytical skills			2	4
Apply interpersonal skills			3	
Be able to work independently			2	6
Apply creativity and innovation			2	4

Skill				
Develop BI Reports from single and multiple systems		2	2	
Work with databases including database design and developments (e.g., SQL server 2016)		2		
Code in a variety of programming languages (C, C++, C#, Python, Java, and R)				5
Review new and existing code to identify areas for improvement				4
Apply business analysis techniques		2	2	
Employ data mining skills			2	
Prioritize workload and work well under pressure	6			5
Apply agile development processes to achieve outstanding data solutions			2	5
Formulate validation strategies and methods to ensure accurate and reliable data			2	6
Ensure correct data and error handling		2	2	5
Provide quick and efficient solutions to data sourcing issues			2	
Develop data models to inform response programming			3	
Stay abreast with the latest developments in the intelligence world. i.e., software and advancements.			2	
Evaluate and improve existing BI systems		2		
Exhibit time management skills			2	5
Apply design thinking			2	
Employ use cases		2		
Build relationships with existing and potential internal customers to understand their individual requirements and demonstrate how products can add value to their business			2	
Stream data			2	
Extract insights and trends from data	6	2	2	4
Work with software developers and solution designers to deliver analytics-driven solutions			2	
Apply forecasting techniques		2		

Table 11 shows an aggregated list compiled from the selection process for BI, BA/BDA, and DS. The list shows skills that were selected by over half of the experts. These were the most important skills for BI, BA/BDA, and DS.

Table 11: Most Important BI, BA/BDA, DS skills

#	Skill
1	Manipulate data using SQL
2	Transform data from different sources and load it to extract insights (ETL)
3	Perform data analysis and validation
4	Perform data modelling (SQL)
5	Use BI/reporting tools (e.g., QlikView, Tableau, Apex etc.)
6	Create visualizations and Dashboards for reporting
7	Prioritize workload and work well under pressure
8	Communicate effectively, verbally and in writing
9	Ensure correct data and error handling

10	Apply agile development processes to achieve outstanding data solutions
11	Exhibit time management skills
12	Demonstrate problem-solving skills
13	Be able to work independently
14	Formulate validation strategies and methods to ensure accurate and reliable data
15	Extract insights and trends from data
16	Demonstrate excellent analytical skills
17	Apply creativity and innovation
18	Code in a variety of programming languages (C, C++, C#, Python, Java, and R)
19	Work with databases including database design and developments (e.g., SQL server 2016)
20	Apply business analysis techniques
21	Review new and existing code to identify areas for improvement
22	Use big data concepts, technologies, and tools
23	Apply interpersonal skills
24	Develop data models to inform response programming
25	Analyze data using statistical and platform analytics tools
26	Develop BI Reports from single and multiple systems
27	Evaluate and improve existing BI systems
28	Employ use cases
29	Apply forecasting techniques
30	Use Cloud technologies (e.g., create data feeds from on-premises to AWS Cloud)
31	Employ data mining skills
32	Provide quick and efficient solutions to data sourcing issues
33	Stay abreast with the latest developments in the intelligence world. i.e., software and advancements.
34	Apply design thinking
35	Build relationships with existing and potential internal customers to understand their individual requirements and demonstrate how products can add value to their business
36	Stream data
37	Work with software developers and solution designers to deliver analytics-driven solutions

4.3.3 Phase 3: Ranking of Skills

In the ranking phase, each expert was asked to rank each skill based on the level of importance. The 37 skills obtained from phase 2 (narrowing down) were used for ranking in this phase. The ranking phase consisted of three rounds. The number of rounds in the ranking phase was determined by the reasonable level of consensus of experts.

4.3.3.1 First Round ranking

The first-round ranking questionnaire consisted of 37 skills obtained from phase 2. According to Keil et al. (2013), the ordering of skills was based on the most frequently mentioned skills in the previous round to the least for each group (BI, BA, BDA, and DS). Experts were asked to rank the top 20 skills out of 37 skills based on their level of importance (Position 1 = most important,

Position 20 = least important). Experts were also asked to provide a brief explanation of the reasoning behind the top five ranked skills.

4.3.3.2 First Round results

At the end of each round, the mean rank was calculated for BI, BA & BDA, and DS. Mean rank ties were not permitted.

4.3.3.2.1 First round ranking for Business Intelligence

The results presented in Table 12 indicate the first-round ranking results. Mean ranks were not permitted because it becomes difficult to compare the importance of skills. Mean ranks highlighted in blue had ties, therefore a second ranking was conducted.

Table 12: First round ranking for BI

Skill	Min	Max	Mean	Std Deviation	Variance	Count
Manipulate data using SQL	1	11	3.11	3.37	11.36	9
Use BI/reporting tools (e.g., QlikView, Tableau, Apex etc)	1	10	4.22	3.31	10.94	9
Transform data from different sources and load it to extract insights (ETL)	2	12	4.67	3.08	9.50	9
Perform data modelling (SQL)	2	13	5.33	3.87	15.00	9
Communicate effectively, verbally and in writing	1	15	6.33	4.15	17.25	9
Create visualizations and Dashboards for reporting	1	12	6.67	3.74	14.00	9
Perform data analysis and validation	1	37	9.2	10.65	113.44	9
Exhibit time management skills	2	17	11.11	4.54	20.61	9
Ensure correct data and error handling	6	17	11.4	3.81	14.52	9
Prioritize workload and work well under pressure	5	37	12.2	10.22	104.44	9
Extract insights and trends from data	7	37	13.8	9.50	90.19	9
Demonstrate problem-solving skills	9	20	14.4	3.32	11.02	9
Formulate validation strategies and methods to ensure accurate and reliable data	8	20	14.6	3.94	15.52	9
Apply agile development processes to achieve outstanding data solutions	7	37	15	8.89	79.00	9
Be able to work independently	11	37	18	7.70	59.25	9
Work with databases including database design and developments (e.g., SQL server 2016)	6	37	18.8	11.12	123.69	9
Apply creativity and innovation	10	37	22.6	11.18	125.02	9
Demonstrate excellent analytical skills	10	37	23	10.79	116.50	9
Apply business analysis techniques	12	37	23.6	10.38	107.77	9
Evaluate and improve existing BI systems	4	37	25.6	13.90	193.27	9

Develop BI Reports from single and multiple systems	3	37	27.2	15.11	228.19	9
Apply interpersonal skills	6	37	29	12.44	154.75	9
Stream data	5	37	29.3	12.17	148.00	9
Analyse data using statistical and platform analytics tools	6	37	31.4	11.42	130.52	9
Code in a variety of programming languages (C, C++, C#, Python, Java, and R)	9	37	32	10.30	106.00	9
Apply forecasting techniques	11	37	34.1	8.67	75.11	9
Work with software developers and solution designers to deliver analytics-driven solutions	14	37	34.4	7.67	58.77	9
Use Cloud technologies (e.g., create data feeds from on-premises to AWS Cloud)	17	37	34.8	6.67	44.44	9
Use big data concepts, technologies, and tools	18	37	34.9	6.33	40.11	9
Develop data models to inform response programming	19	37	35	6.00	36.00	9
Employ data mining skills	37	37	35	6.00	36.00	9
Review new and existing code to identify areas for improvement	20	37	35.1	5.67	32.11	9
Employ use cases	20	37	35.1	5.67	32.11	9
Provide quick and efficient solutions to data sourcing issues	37	37	37	0.00	0.00	9
Stay abreast with the latest developments in the intelligence world. i.e., software and advancements.	37	37	37	0.00	0.00	9
Apply design thinking	37	37	37	0.00	0.00	9
Build relationships with existing and potential internal customers to understand their individual requirements and demonstrate how products can add value to their business	37	37	37	0.00	0.00	9

4.3.3.2.2 First round ranking for Business Analytics & Big Data Analytics
Given that the number of respondents for each of BA and BDA were below 7 as part of the requirement for the Delphi method according to Pare et. al., (2013), the two groups were combined based on their focus on analytics. A second-round ranking was conducted as mean ranks were also present in the results highlighted in blue.

Table 13: First round ranking for BA/BDA

Skill	Min	Max	Mean	Std dev	Variance	Count
Communicate effectively, verbally and in writing	2	13	6.57	4.2	17.6	7
Demonstrate problem-solving skills	1	18	8.86	7.48	55.95	7
Perform data analysis and validation	4	18	9.57	4.45	19.8	7
Transform data from different sources and load it to extract insights (ETL)	3	37	9.86	12.3	150.14	7
Ensure correct data and error handling	5	17	9.86	4.11	16.9	7
Prioritize workload and work well under pressure	2	37	10.71	12	144.95	7
Apply agile development processes to achieve outstanding data solutions	8	16	11.28	3.06	9.33	7
Apply creativity and innovation	1	37	11.29	12.4	153	7
Perform data modelling (SQL)	2	37	11.57	11.5	132.9	7
Manipulate data using SQL	1	37	12	12.5	157	7
Demonstrate excellent analytical skills	8	20	12.86	4.76	22.66	7
Exhibit time management skills	6	37	14	10.7	114.8	7
Formulate validation strategies and methods to ensure accurate and reliable data	6	37	15	10.2	105	7
Build relationships with existing and potential internal customers to understand their individual requirements and demonstrate how products can add value to their business	1	37	15.43	15.6	244.33	7
Extract insights and trends from data	1	37	15.43	17.4	301.57	7
Be able to work independently	6	37	16.43	12.8	163.61	7
Apply design thinking	2	37	16.57	15.8	249.9	7
Code in a variety of programming languages (C, C++, C#, Python, Java, and R)	2	37	17.14	15.4	236.14	7
Review new and existing code to identify areas for improvement	6	37	18	14.5	209.47	7
Apply interpersonal skills	4	37	20.28	16.1	258.23	7
Stay abreast with the latest developments in the intelligence world. i.e., software and advancements.	7	37	20.86	13.8	190.14	7
Stream data	14	37	22.14	11.3	127	7
Use BI/reporting tools (e.g., QlikView, Tableau, Apex etc)	13	37	22.14	10.7	115.28	7
Create visualizations and Dashboards for reporting	8	37	22.71	13.4	181.8	7
Provide quick and efficient solutions to data sourcing issues	5	37	23	13.5	181.9	7
Evaluate and improve existing BI systems	7	37	23.57	12.7	161.57	7
Use big data concepts, technologies, and tools	14	37	24.28	10.5	110.8	7
Use Cloud technologies (e.g., create data feeds from on-premises to AWS Cloud)	13	37	24.57	10.4	108	7

Work with databases including database design and developments (e.g., SQL server 2016)	14	37	26.14	10.1	102.14	7
Employ use cases	3	37	26.43	12.9	165.14	7
Apply business analysis techniques	11	37	26.86	9.83	96.57	7
Work with software developers and solution designers to deliver analytics-driven solutions	15	37	27.43	8.32	69.14	7
Analyse data using statistical and platform analytics tools	18	37	29	7.18	51.57	7
Develop data models to inform response programming	19	37	29.57	6.8	46.28	7
Employ data mining skills	20	37	30.14	6.43	41.28	7
Develop BI Reports from single and multiple systems	37	37	30.29	0	0	7
Apply forecasting techniques	37	37	30.57	0	0	7

4.3.3.2.3 First round ranking for Data Science
First round ranking for DS shows some ties as well in the mean rank, therefore a second-round ranking was also conducted.

Table 14: First round ranking for DS

Skills	Min	Max	Mean	Std dev	variance	Count
Perform data analysis and validation	3	9	5.25	2.38	5.64	8
Transform data from different sources and load it to extract insights (ETL)	2	37	8.75	11.78	138.78	8
Code in a variety of programming languages (C, C++, C#, Python, Java, and R)	1	37	10.63	13.18	173.69	8
Create visualizations and Dashboards for reporting	6	37	12.5	10.38	107.71	8
Demonstrate problem-solving skills	1	37	13	15.45	238.57	8
Extract insights and trends from data	2	37	13.63	10.58	111.98	8
Prioritize workload and work well under pressure	6	37	14.25	9.85	97.07	8
Communicate effectively, verbally and in writing	8	37	14.25	9.78	95.64	8
Ensure correct data and error handling	4	37	15.75	13.55	183.64	8
Demonstrate excellent analytical skills	4	37	15.75	10.21	104.21	8
Manipulate data using SQL	1	37	16.25	13.98	195.35	8
Formulate validation strategies and methods to ensure accurate and reliable data	4	37	16.63	13.02	169.41	8
Be able to work independently	2	37	17.63	12.96	167.98	8
Apply creativity and innovation	8	37	17.88	8.46	71.55	8

Skill						
Apply agile development processes to achieve outstanding data solutions	5	37	18.25	12.4	153.64	8
Exhibit time management skills	8	37	19.13	11.56	133.55	8
Use big data concepts, technologies, and tools	3	37	19.5	15.27	233.14	8
Analyse data using statistical and platform analytics tools	2	37	20.75	17.47	305.35	8
Perform data modelling (SQL)	4	37	21.25	13.99	195.64	8
Employ data mining skills	4	37	22.88	15.36	235.83	8
Use Cloud technologies (e.g., create data feeds from on-premises to AWS Cloud)	5	37	23	12.39	153.42	8
Work with databases including database design and developments (e.g., SQL server 2016)	10	37	23.63	11.43	130.55	8
Use BI/reporting tools (e.g., QlikView, Tableau, Apex etc)	5	37	24	14.23	202.57	8
Develop data models to inform response programming	11	37	27.63	12.95	167.69	8
Stay abreast with the latest developments in the intelligence world. i.e., software and advancements.	1	37	28.13	13.52	182.69	8
Apply forecasting techniques	13	37	29.13	10.96	120.12	8
Apply design thinking	17	37	30.25	9.36	87.64	8
Apply interpersonal skills	1	37	30.38	13.28	176.26	8
Work with software developers and solution designers to deliver analytics-driven solutions	7	37	30.88	11.72	137.26	8
Build relationships with existing and potential internal customers to understand their individual requirements and demonstrate how products can add value to their business	3	37	32.75	12.02	144.5	8
Review new and existing code to identify areas for improvement	7	37	33.25	10.61	112.5	8
Develop BI Reports from single and multiple systems	14	37	34.13	8.13	66.12	8
Employ use cases	16	37	34.38	7.42	55.12	8
Stream data	19	37	34.75	6.36	40.5	8
Apply business analysis techniques	20	37	34.88	6.01	36.12	8
Evaluate and improve existing BI systems	37	37	37	0	0	8
Provide quick and efficient solutions to data sourcing issues	37	37	37	0	0	8

Ties in the mean rank were identified as shown in the Tables above, which made it difficult to decide which skill was more important than the other. A second-round ranking was conducted to get rid of ties in the mean rank.

4.3.3.2 Second Round Ranking
In this phase, another survey was sent out to experts and asked to rank each skill by dragging the skill to a position in order of its importance relative to other skills. This method eliminates the chances of getting ties. Skills on the survey were ordered by their mean ranks obtained from the

first round. Table 18 showed a contrast between the results from the first and second round mean ranks.

4.3.3.2.1 Second ranking for Business Intelligence

A second-round questionnaire was developed and sent out to BI professionals. Mean rank results shows the present of ties which are highlighted in blue. A Kendall's Coefficient was also calculated in this round to determine the level of agreement. The Kendall's W for this round was 0.29 which indicated a weak degree of agreement amongst experts. In this round BI had 8 participants due to one expert who decided to withdraw from the study.

Table 15: Second round ranking for BI

Skill	Minimum	Maximum	Mean	Std Deviation	Variance	Count
Manipulate data using SQL	1	11	4.5	3.46	13.71	8
Use BI/reporting tools (e.g., QlikView, Tableau, Apex etc)	1	12	5.38	3.97	15.73	8
Transform data from different sources and load it to extract insights (ETL)	1	13	6.5	4.27	18.25	8
Perform data modelling (SQL)	2	16	7.75	4.15	17.19	8
Create visualizations and Dashboards for reporting	2	12	7.88	3.33	11.11	8
Ensure correct data and error handling	4	16	8.38	4.39	19.23	8
Perform data analysis and validation	2	17	9.13	4.43	19.61	8
Demonstrate problem-solving skills	1	16	9.75	4.58	20.94	8
Work with databases including database design and developments (e.g., SQL server 2016)	1	20	10	7.75	60	8
Formulate validation strategies and methods to ensure accurate and reliable data	4	16	10.63	4.15	17.23	8
Communicate effectively, verbally and in writing	4	18	10.88	5.88	34.61	8
Extract insights and trends from data	6	16	11.75	4.02	16.19	8
Demonstrate excellent analytical skills	2	20	11.75	6.59	43.44	8
Apply business analysis techniques	1	19	11.75	6.55	42.94	8
Apply agile development processes to achieve outstanding data solutions	4	19	12.25	5.12	26.19	8
Prioritize workload and work well under pressure	3	19	12.38	4.74	22.48	8
Apply creativity and innovation	6	18	13.25	3.93	15.44	8
Evaluate and improve existing BI systems	3	20	13.75	5.31	28.19	8
Exhibit time management skills	8	20	14.75	4.79	22.94	8
Be able to work independently	14	20	17.63	1.73	2.98	8
Kendall's W	**0.29**					

A second-round questionnaire was developed and sent out to BI professionals. Mean rank results shows the present of ties which are highlighted in blue. A Kendall's Coefficient was also calculated in this round to determine the level of agreement. The Kendall's W for this round was 0.29 which indicated a weak degree of agreement amongst experts. In this round BI had 8 participants due to one expert who decided to withdraw from the study.

4.3.3.2.2 Second round ranking for Business Analytics & Big Data Analytics
Ties were still present in the BA & BDA group. A Kendall's W of 0.37 was noted and indicates a weak level of agreement amongst experts. Another round of ranking was calculated (Table 16).

Table 16: Second round ranking for BA & BDA

Skill	Minimum	Maximum	Mean	Std Deviation	Variance	Count
Demonstrate problem-solving skills	1	6	2.57	2.07	4.28	7
Communicate effectively, verbally and in writing	1	13	5.14	3.98	15.80	7
Perform data analysis and validation	2	16	6.71	4.99	24.90	7
Transform data from different sources and load it to extract insights (ETL)	3	17	7.29	5.12	26.23	7
Ensure correct data and error handling	3	14	8	4.08	16.66	7
Prioritize workload and work well under pressure	4	18	8.14	4.85	23.47	7
Build relationships with existing and potential internal customers to understand their individual requirements and demonstrate how products can add value to their business	1	20	8.86	7.95	63.14	7
Exhibit time management skills	3	15	9.29	3.95	15.57	7
Demonstrate excellent analytical skills	2	17	9.86	5.15	26.47	7
Perform data modelling (SQL)	6	16	10.43	3.31	10.95	7
Apply creativity and innovation	5	16	10.86	4.02	16.14	7
Manipulate data using SQL	5	18	10.86	4.34	18.80	7
Apply interpersonal skills	2	20	12	7.57	57.33	7

Skill	Min	Max	Mean	Std Dev	Variance	Count
Apply agile development processes to achieve outstanding data solutions	7	19	12.14	4.49	20.14	7
Be able to work independently	3	20	12.57	6.27	39.28	7
Extract insights and trends from data	6	19	13.86	4.85	23.57	7
Code in a variety of programming languages (C, C++, C#, Python, Java, and R)	1	20	14.29	6.8	46.23	7
Formulate validation strategies and methods to ensure accurate and reliable data	13	18	15.14	1.95	3.80	7
Apply design thinking	7	20	15.57	4.69	21.95	7
Review new and existing code to identify areas for improvement	12	19	16.43	3.05	9.28	7
Kendall's W					**0.37**	

4.3.3.2.3 Second round ranking for Data Science

The second-round ranking for DS had some mean ties in them and the Kendall's W of 0.35 indicated a weak degree of agreement, hence a third-round ranking was conducted (Table 17). In this round DS had 7 participants due to one expert who decided to withdraw from the study.

Table 17: Second round ranking for DS

Skill	Minimum	Maximum	Mean	Std Deviation	Variance	Count
Demonstrate problem-solving skills	1	13	5	4.21	17.71	7
Formulate validation strategies and methods to ensure accurate and reliable data	1	16	5.43	4.75	22.53	7
Demonstrate excellent analytical skills	1	16	6.71	5.01	25.06	7
Ensure correct data and error handling	1	13	7	4	16	7
Transform data from different sources and load it to extract insights (ETL)	1	16	7.43	4.81	23.1	7
Communicate effectively, verbally and in writing	1	14	7.43	4.1	16.82	7
Perform data analysis and validation	3	15	8.43	3.89	15.1	7
Be able to work independently	1	17	9.14	5.82	33.84	7
Extract insights and trends from data	2	15	9.43	4.1	16.82	7
Analyse data using statistical and platform analytics tools	5	19	10.57	5.53	30.53	7
Apply creativity and innovation	5	18	10.86	4.12	16.98	7
Manipulate data using SQL	4	18	11.29	5.2	27.06	7
Exhibit time management skills	2	18	11.29	5.72	32.78	7

Prioritize workload and work well under pressure	6	16	11.57	2.92	8.53	7
Create visualizations and Dashboards for reporting	7	17	12.43	2.97	8.82	7
Code in a variety of programming languages (C, C++, C#, Python, Java, and R)	4	19	13.29	6.06	36.78	7
Apply agile development processes to achieve outstanding data solutions	5	19	14.71	4.37	19.06	7
Perform data modelling (SQL)	4	20	15.29	5.57	31.06	7
Use big data concepts, technologies, and tools	8	19	15.57	3.54	12.53	7
Employ data mining skills	9	20	17.14	4.55	20.69	7
Kendall's W	0.35					

4.3.3.3 Second round results

By making a closer inspection between the two mean ranks from first and second round, tie ranks are still present. Kendall's coefficient of concordance (W) was also calculated to determine the level of agreement. A Kendall's W of 0.29 for BI, 0.37 for BA/BDA, and 0.35 for DS indicated a weak degree of agreement among experts. A third-round ranking was conducted using the mean rank for each skill from the second round.

4.3.3.4 Third round ranking

In this round, a survey with skills from the previous round was presented to the experts for further ranking. A Kendall's W of 0.69 for BI, 0.67 for BA/BDA, and 0.75 for DS were achieved which indicated an increase and a relatively good agreement among experts.

4.3.3.5 Third round results
4.3.3.5.1 Third round ranking for Business Intelligence

Table 18 shows a comparison of three mean ranks from three different rounds as well as their Kendall's W. The third-round ranking in BI showed a higher Kendall's W of 0.69 which indicates relatively good agreement amongst experts. Therefore, a consensus was reached.

Table 18: Third round ranking for BI

Skill	Round 1 Mean rank	Round 2 Mean rank	Round 3 Mean rank
Manipulate data using SQL	3.11	4.5	2.29
Use BI/reporting tools (e.g., QlikView, Tableau, Apex etc)	4.22	5.38	3.86
Transform data from different sources and load it to extract insights (ETL)	4.67	6.5	1.57
Perform data modelling (SQL)	5.33	7.75	5.14
Communicate effectively, verbally and in writing	6.33	10.88	8

Create visualizations and Dashboards for reporting	6.67	7.88	8.4
Perform data analysis and validation	9.2	9.13	7.14
Exhibit time management skills	11.11	14.75	10.86
Ensure correct data and error handling	11.4	8.38	8.57
Prioritize workload and work well under pressure	12.2	12.38	11.14
Extract insights and trends from data	13.8	11.75	9.14
Demonstrate problem-solving skills	14.4	9.75	12.57
Formulate validation strategies and methods to ensure accurate and reliable data	14.6	10.63	14
Apply agile development processes to achieve outstanding data solutions	15	12.25	13.14
Be able to work independently	18	17.63	14.57
Work with databases including database design and developments (e.g., SQL server 2016)	18.8	10	15
Apply creativity and innovation	22.6	13.25	17.29
Demonstrate excellent analytical skills	23	11.75	15.29
Apply business analysis techniques	23.6	11.75	13
Evaluate and improve existing BI systems	25.6	13.75	19.43
Develop BI Reports from single and multiple systems	27.2		
Apply interpersonal skills	29		
Stream data	29.3		
Analyse data using statistical and platform analytics tools	31.4		
Code in a variety of programming languages (C, C++, C#, Python, Java, and R)	32		
Apply forecasting techniques	34.1		
Work with software developers and solution designers to deliver analytics-driven solutions	34.4		
Use Cloud technologies (e.g., create data feeds from on-premises to AWS Cloud)	34.8		
Use big data concepts, technologies, and tools	34.9		
Develop data models to inform response programming	35		
Employ data mining skills	35		
Review new and existing code to identify areas for improvement	35.1		
Employ use cases	35.1		
Provide quick and efficient solutions to data sourcing issues	37		
Stay abreast with the latest developments in the intelligence world. i.e. software and advancements.	37		
Apply design thinking	37		
Build relationships with existing and potential internal customers to understand their individual requirements and demonstrate how products can add value to their business	37		
Kendall's W		**0.29**	**0.69**

4.3.3.5.2 Third round ranking for Business Analytics & Big Data Analytics
A comparison of the three rounds was noted. The Kendall's W of 0.67 was indicated which showed a high level of agreement amongst experts. A consensus was reached, and no more ranking rounds were conducted (Table 19).

Table 19: Third round ranking for BA/BDA

Skill	Round 1 Mean rank	Round 2 Mean rank	Round 3 Mean rank
Communicate effectively, verbally and in writing	6.57	5.14	7.29
Demonstrate problem-solving skills	8.86	2.57	15
Perform data analysis and validation	9.57	6.71	11.29
Transform data from different sources and load it to extract insights (ETL)	9.86	7.29	12.71
Ensure correct data and error handling	9.86	8	13
Prioritize workload and work well under pressure	10.71	8.14	7.57
Apply agile development processes to achieve outstanding data solutions	11.28	12.14	5.86
Apply creativity and innovation	11.29	10.86	4
Perform data modelling (SQL)	11.57	10.43	3
Manipulate data using SQL	12	10.86	3.14
Demonstrate excellent analytical skills	12.86	9.86	6.71
Exhibit time management skills	14	9.29	6.86
Formulate validation strategies and methods to ensure accurate and reliable data	15	15.14	8.57
Build relationships with existing and potential internal customers to understand their individual requirements and demonstrate how products can add value to their business	15.43	8.86	11.43
Extract insights and trends from data	15.43	13.86	12.57
Be able to work independently	16.43	12.57	12.71
Apply design thinking	16.57	15.57	14.43
Code in a variety of programming languages (C, C++, C#, Python, Java, and R)	17.14	14.29	17.14
Review new and existing code to identify areas for improvement	18	16.43	17.71
Apply interpersonal skills	20.28	12	19
Stay abreast with the latest developments in the intelligence world. i.e., software and advancements.	20.86		
Stream data	22.14		
Use BI/reporting tools (e.g., QlikView, Tableau, Apex etc)	22.14		
Create visualizations and Dashboards for reporting	22.71		
Provide quick and efficient solutions to data sourcing issues	23		
Evaluate and improve existing BI systems	23.57		
Use big data concepts, technologies, and tools	24.28		
Use Cloud technologies (e.g., create data feeds from on-premises to AWS Cloud)	24.57		

Work with databases including database design and developments (e.g., SQL server 2016)	26.14		
Employ use cases	26.43		
Apply business analysis techniques	26.86		
Work with software developers and solution designers to deliver analytics-driven solutions	27.43		
Analyse data using statistical and platform analytics tools	29		
Develop data models to inform response programming	29.57		
Employ data mining skills	30.14		
Develop BI Reports from single and multiple systems	30.29		
Apply forecasting techniques	30.57		
Kendall's W		**0.37**	**0.67**

4.3.3.5.3 Third round ranking for Data Science
A consensus was reached in the third round. The Kendall's W coefficient of 0.75 was achieved. The results show a strong level agreement among experts (Table 20).

Table 20: Third round for DS

Skill	Round 1 Mean rank	Round 2 Mean rank	Round 3 Mean rank
Perform data analysis and validation	5.3	8.43	7
Transform data from different sources and load it to extract insights (ETL)	8.8	7.43	5.57
Code in a variety of programming languages (C, C++, C#, Python, Java, and R)	10.6	13.29	5.29
Create visualizations and Dashboards for reporting	12.5	12.43	14
Demonstrate problem-solving skills	13	5	14.43
Extract insights and trends from data	13.6	9.43	5.86
Prioritize workload and work well under pressure	14.3	11.57	5.43
Communicate effectively, verbally and in writing	14.3	7.43	15
Ensure correct data and error handling	15.8	7	14.43
Demonstrate excellent analytical skills	15.8	6.71	13
Manipulate data using SQL	16.3	11.29	14.71
Formulate validation strategies and methods to ensure accurate and reliable data	16.6	5.43	14.29
Be able to work independently	17.6	9.14	16
Apply creativity and innovation	17.9	10.86	19.43
Apply agile development processes to achieve outstanding data solutions	18.3	14.71	13.43

Exhibit time management skills	19.1	11.29	7.86
Use big data concepts, technologies, and tools	19.5	15.57	2.14
Analyse data using statistical and platform analytics tools	20.8	10.57	13.86
Perform data modelling (SQL)	21.3	15.29	4
Employ data mining skills	22.9	17.14	4.29
Use Cloud technologies (e.g., create data feeds from on-premises to AWS Cloud)	23		
Work with databases including database design and developments (e.g., SQL server 2016)	23.6		
Use BI/reporting tools (e.g., QlikView, Tableau, Apex etc)	24		
Develop data models to inform response programming	27.6		
Stay abreast with the latest developments in the intelligence world. i.e., software and advancements.	28.1		
Apply forecasting techniques	29.1		
Apply design thinking	30.3		
Apply interpersonal skills	30.4		
Work with software developers and solution designers to deliver analytics-driven solutions	30.9		
Build relationships with existing and potential internal customers to understand their individual requirements and demonstrate how products can add value to their business	32.8		
Review new and existing code to identify areas for improvement	33.3		
Develop BI Reports from single and multiple systems	34.1		
Employ use cases	34.4		
Stream data	34.8		
Apply business analysis techniques	34.9		
Evaluate and improve existing BI systems	37		
Provide quick and efficient solutions to data sourcing issues	37		
Kendall's W		**0.35**	**0.75**

4.4 Venn diagram showing all three skills domains

A comparison of coded themes was analyzed in NVivo to answer research question 2. To do this, the coded data was compared in three distinct domains namely BI, BA/BDA, and DS. Figure 14 (a) illustrates the overlapping of the top skills amongst BI, BA/BDA, and DS. Several similarities have been noted amongst BI, BA/BDA, and DS, with skills such as business analysis, data manipulation and modelling. Furthermore, some overlaps of skills were also presented in DS and BA & BDA such as programming using various languages. BI jobs required BI reporting tools, database skills and ability to apply business analysis skills, whereas DS required data mining and the use of statistical tools to perform data analysis. BDA emphasized skills on building relationships with customers, interpersonal skills, and design thinking.
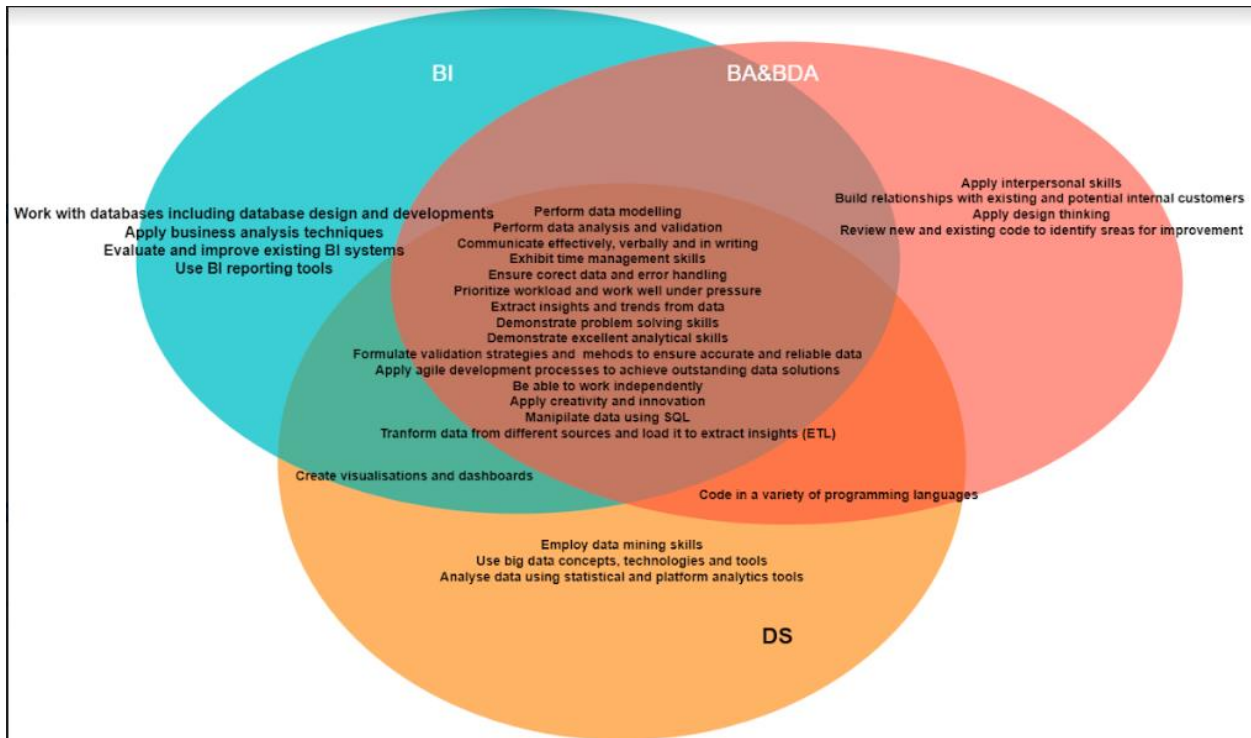

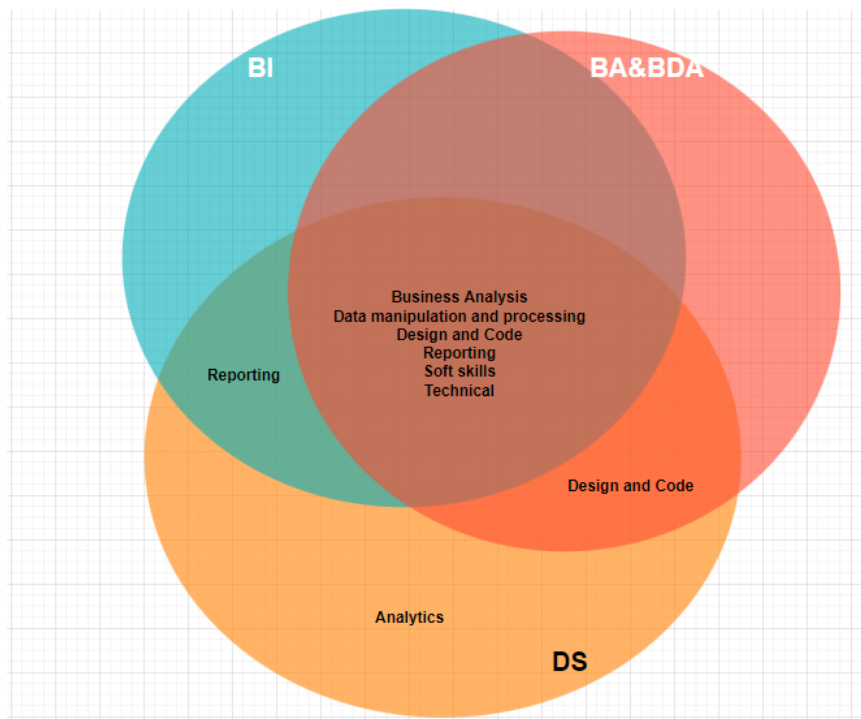*Figure 14 (a): Venn diagram depicting skills domains*

Figure 14(b): Venn diagram depicting skills categories

4.5 Qualitative data analysis about reasons for top-ranked skills

Thematic analysis was also employed to analyze reasons provided as their top five ranked skills. The responses were first recorded on an Excel spreadsheet with manually generated codes to represent the category in which the respondent was answering, e.g., PDS1 refers to participant 1 from the DS category and later imported to NVivo to analyze the text responses individually. The imported data in NVivo was assigned a unique ID (Figure 15).

Figure 15: Imported data in NVivo

The next step was to analyze each individual response by coding the text to make nodes as shown in Figure 16.

Figure 16: Coding process in NVivo

The initial coding has shown some themes and reasons emerging on the top ranked skills. A review of themes was conducted to ensure themes that provided an explicit and distinct explanation remained, for example "*Human interaction for communication*" was carefully reviewed to "*Communication within team members for collaboration of ideas.*" Table 21 provides a summary of reasons provided by individual experts from the survey.

59

Category	Reason for top ranked skills	Raw data
BI	- BI focuses on creating reports, visualizations, and dashboards - Ability to use BI tools, like PowerBI and Tableau - Knowledge of ETL to transform data from multiple end points	*"In all Business Intelligence projects I have worked on; all the top 5 skills were needed to complete the tasks. Business Intelligence focuses a lot on producing visualizations to be consumed by management teams, so one has to be skilled at creating Reports and Dashboards using tools like Power BI and Tableau"* *"ETL is a process data engineers use to change large sets of data. When we leave the work of aggregating and transforming data into a format usable by a client application, we're making them do ETL. They must extract the data from multiple endpoints, transform it into a data set usable by the application and then load it into the UI. ETL is a data pipeline that first extracts data from the source, transforms the data models that analysts can then turn into reports and dashboards, then to finally be loaded into data warehouses."*
BA/BDA	- Design and Implementation, and design thinking - SQL as a necessity - Provision of data solutions - Understanding client's business domain - Software programming as a requirement - Knowledge of ETL and data extraction to transform data from multiple end points - Most in demand tech - Problem solving- ability to solve problems learn - Communication within team members for collaboration of ideas	*"The most important tool I found to be helpful is actually understanding the client's business domain, what they are trying to achieve and how they want to achieve it. Then the focus should go into design, and implementation should follow.", "These are the top 5 objectives for big data/Business analytics. Extracting trends and ACTIONABLE insights based off descriptive, predictive, and predictive stats is important. Design thinking is a pivotal way forward in digital and incorporating with a data aspect is powerful. ETLS and extracting reports are still important, although these are more BI related, but still add value minds that play with data and make it meaningful, special attention needs to be given to our ability to be resilient, both in time and effort."*

| DS | • Most in-demand tech
• Identification of patterns
• Ability to analyze and check for data
• To advise on valuable decision making
• Development process made easy and simpler
• Software programming as a requirement
• Knowledge of ETL and data extraction to transform data from multiple end points
• BI focuses on creating reports, visualizations, and dashboards
• Cleaning and preparing data for analysis
• Communication within team members for collaboration of ideas
• Data integrity
• Ability to make sense out of data
• Building relationships with clients
• Problem solving ability to solve problems and learn new additional skills | *"You need to also be able to analyze data and check for errors.", "As a data science professional, your main job is to extract insights from datasets to help organizations solve complex problems. You need to be a problem solver. Data science professionals spend most of their time cleaning and preparing data for analysis. They do this using different programming languages such as R, Python, SQL, ... etc. "Big data tools and technologies is essential due to the big data that is generated daily. A Data Scientist must have excellent analytical skills to find insights within data. Visualizations and dashboards are important with regards to getting a point across and showing the relationships, and interactions within the raw data, which is not usually explicitly known work with big data technologies, and ability to write and code which will enable the DS to carryout his/her duties of analyzing big data., 5 are based on knowledge of programming language that is needed to load and transform the data and making sure the end product is based on data that is reliable and accurate as this is the most crucial aspect of all data", "Helps identify which programming language is easier to code with and how the user interface can be designed.", "It is well established that organizations conduct big data analytics on the available big data to obtain valuable information to advise their decision making"* |

According to Table 21, the top ranked skills in BI was based on the ability to use BI tools for visualizations and the creation of dashboards for reporting purposes. Knowledge of data extraction and transformation was seen to be the most important for effective job performance in BI. This is evident in Table 22 which shows the number of times the skills have been ranked in the top five *(Manipulate data using SQL, use BI/reporting tools (e.g., QlikView, Tableau, Apex etc.), transform data from different sources and load it to extract insights (ETL), perform data modelling (SQL), communicate effectively, verbally and in writing, create visualizations and Dashboards for reporting).*

In the BA/BDA category, understanding the clients' business domain, communication, and problem-solving skills have shown a predominance in this category. Ability to learn additional skills will enable an individual to solve complex problems. Furthermore, communication has been

pointed out to be vital as most experts work in team-based environments thus sharing of skills within a team is enabled.

Lastly, DS category indicated the need to have the knowledge for data cleaning and preparation for analysis as a requisite skill to perform their jobs effectively. In addition, identification of patterns in data and make sense out of it. Additional reasons included the most in-demand technologies such as big data to obtain valuable information. Table 21 showed some of the top ranked skills for DS *(Employ data mining skills, perform data modelling, transform data from different sources and load it to extract insights (ETL).*

4.6 Summary of reasons for Top 5 placements

Table 22 shows a summary of reasons behind the top 5 skill rankings. A brief explanation was provided by experts why these skills were top ranked. However, some experts did not provide their reasons for top ranked skills.

Table 22: Summary for top ranked skills

Skill	Category	Number of times listed in top 5 ranking	Data Extract
Manipulate data using SQL	BI, BA/BDA, DS	4	In all Business Intelligence projects I have worked on; all the top 5 skills were needed in order to complete the tasks. Business Intelligence focuses a lot on producing visualisations to be consumed by management teams, so one has to be skilled at creating Reports and Dashboards using tolls like Power BI and Tableau"
Use BI/reporting tools (e.g., QlikView, Tableau, Apex etc)	BI	3	"Business Intelligence focuses a lot on producing visualisations to be consumed by management teams, so one has to be skilled at creating Reports and Dashboards using tolls like Power BI and Tableau"
Transform data from different sources and load it to extract insights (ETL)	BI, BA/BDA, DS	7	"ETL is a process data engineers use to change large sets of data. When we leave the work of aggregating and transforming data into a format usable by a client application, we're making them do ETL. They must extract the data from multiple endpoints, transform it into a data set usable by the application and then load it into the UI. ETL is a data pipeline that first extracts data from the source, transforms the data models that analysts can then turn into reports and dashboards, then to finally be loaded into data warehouses."
Perform data modelling (SQL)	BI, BA/BDA, DS	4	"SQL appears indispensable into today word of data analytics. Software programming and all its requirements are necessary.

			BI and ETL will always be here"
Communicate effectively, verbally and in writing	BI, BA/BDA, DS	5	
Create visualizations and Dashboards for reporting	BI, DS	2	'Visualizations and dashboards are important with regards to getting a point across and showing the relationships, and interactions within the raw data, which is not usually explicitly known."
Perform data analysis and validation	BI, BA/BDA, DS	5	
Ensure correct data and error handling	BI, BA/BDA, DS	2	
Prioritize workload and work well under pressure	BI, BA/BDA, DS	1	"Effective prioritising of workload will slightly decrease pressure, allowing more time to problem-solve the best way possible. Big Data technologies is the most in-demand tech skill"
Extract insights and trends from data	BI, BA/BDA, DS	1	
Demonstrate problem-solving skills	BI, BA/BDA, DS	4	"Being a problem-solver is the most important skill to have and develop daily. A problem-solver will remain curious and learn additional skills (such as those listed outside the top 20) if required. If one can problem-solve, it becomes easier to innovate and apply creativity"
Formulate validation strategies and methods to ensure accurate and reliable data	BI, BA/BDA, DS	1	
Apply agile development processes to achieve outstanding data solutions	BI, BA/BDA, DS	1	
Apply creativity and innovation	BI, BA/BDA, DS	2	
Demonstrate excellent analytical skills	BI, BA/BDA, DS	1	
Code in a variety of programming languages	BA/BDA, DS	2	"It is necessary to know multiple languages, this

(C, C++, C#, Python, Java, and R)			ensures flexibility when it comes to the implementation of code within the language that is best suited for the solution"
Apply design thinking	BA/BDA	1	

4.7 Additional Analysis by four groups (limitations acknowledged)

An additional analysis of 4 groups was conducted to investigate how the skills could have presented themselves if BA/BDA were not combined to satisfy the requirements of the Delphi method. The findings presented the same results as the ones obtained from Figure 14 (a), but the ranking of the skills is the one that has shown some importance in other skills over the other.
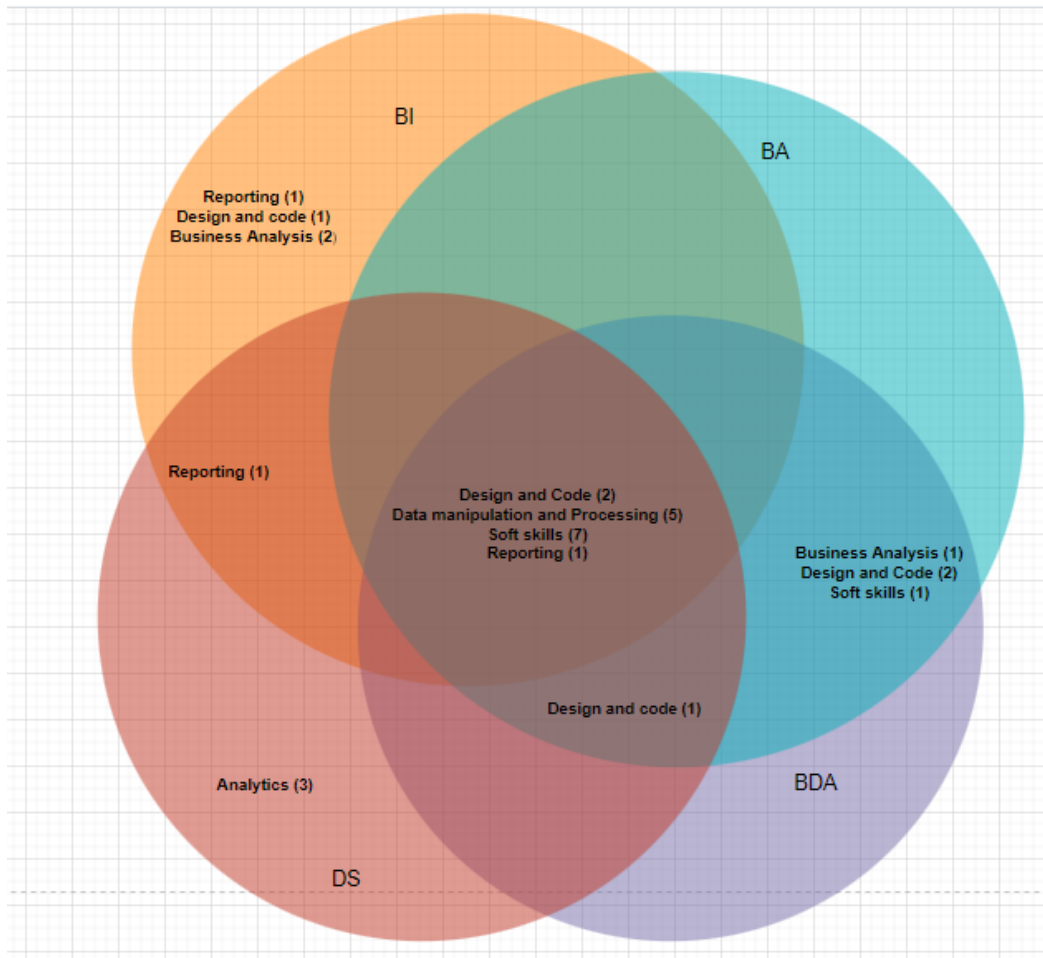
Figure 17: Analysis by four groups of skills domains against skills categories (BI, BA, BDA, DS)

Findings have shown that analytics is a core skill in Data science. In addition, professionals in Data science need to have senior-level experience such as 4-6 years as depicted in Figure 9. On the other hand, Business intelligence requires 0-3 years' experience for most of its roles. This suggests that Business intelligence accommodates junior entry-level roles. From Figure 17, the number of skills per category in brackets indicates the number of skills contributing to a specific domain. For example, the design and code category are a requirement for all domains, but it is only one skill indicated for overall domains. However, BI also has a component of the design and code category that works with databases, *including database design and developments (e.g., SQL server 2016).*

4.8 Discussion of Findings

The purpose of the research was to identify requisite skills for BI, BA, BDA, and DS. The aim was to (1) establish common skills within BI, BA, BDA, and DS, (2) identify any intersecting skills, (3) identify any sub-profiles within the roles for BI, BA, BDA, and DS.
Results of this study are based on the analysis of data obtained from online job ads and literature review, followed by the Delphi method applied to three groups namely BI, BA/ BDA, and DS. BA & BDA were combined to form one category since the Delphi method requires a minimum of 7 respondents. In addition, the two groups were combined since they had analytics as a common focus.

4.8.1 Common Skills Categories
Research findings have shown some similarities in the skills category for BI, BA/BDA, and DS. Skills categories that were predominant in BI, BA/BDA, and DS include **Design and code** (*Perform data modelling (SQL), apply agile development processes to achieve outstanding data solutions,* **Soft skills** *(Communicate effectively, verbally and in writing, exhibit time management skills, prioritize workload and work well under pressure, demonstrate problem-solving skills, demonstrate excellent analytical skills, be able to work independently, apply creativity and innovation),* **Data manipulation and processing** *(formulate validation strategies and methods to ensure accurate and reliable data, manipulate data using SQL, transform data from different sources and load it to extract insights (ETL), Perform data analysis and validation , ensure correct data and error handling),* **Reporting** *(extract insights and trends from data).).* Findings presented an overlap in skills within BI & DS, namely creating *visualizations and dashboards. Conversely, DS and BA/BDA have one skill in common: to code in various programming languages*. Similar findings reported programming skills as a requisite in Data science. A data scientist's role is to transform both structured and unstructured data into insights (Cao, 2017; Linden, Alaybeyi & Vashisth, 2019). The conceptual model has provided some guidelines on skills required in three domains (BI, BA/BDA, and DS) which have been validated. For example, programming skills were a requisite in BA/BDA, and DS. Furthermore, an understanding of tools applied to data such as QlikView, machine learning, database administration and statistical tools have been highlighted to be a core requisite for professionals working in BI, BA/BDA, and DS (Derbortoli et al., 2014; Hattingh, et al. 2019). Skills such as business analysis have been highlighted in the conceptual model to be a requirement in BI and BA/BDA and findings have shown the need for business analysis in these two domains. In addition, one respondent had this to say, "willingness to understand the business context". In a nutshell, business acumen is a requisite when working in the data age as well as knowledge of tools involved to make sense out of data (Hattingh, Marshall, Holmer, & Naidoo, 2019).

Literature gave a snapshot of the roles within the Data science since it has been noted as a new buzzword with roles such as Data scientist, and Data Architect. The Data Architect is responsible for data storage, managing data warehouses for various projects, and providing advice when needed (Mount & Zumei, 2019). Findings have shown roles within DS such as Data Architect, Data Scientist, Machine Learning Engineer, Data Engineer, Data Analyst. However, Mount & Zumel (2019) postulate that sometimes these roles may overlap, which was evident in BA/BDA and DS in roles such as Data Scientist, Data Engineer, Data Architect, and Data Analyst (see table 4)

In addition, literature review has highlighted Soft skill category to be common across the four domains. For the analysis of skills at the individual level rather than a category level, an interesting observation in the literature review is that of *applying interpersonal skills* which is a requisite in BI. However, from the ranking of skills that has been conducted, applying interpersonal skills is only a top requisite in the BA/ BDA category.

4.8.2 Unique Highly Ranked Skills
Findings have shown distinct and unique, highly ranked skills in each category (BI, BA, BDA, and DS). For the BI domain *using BI/reporting tools* was BI's most highly ranked skill. Some uniquely BI skills were never ranked in the top 5, for example, *working with databases including database design and developments (e.g., SQL server 2016), apply business analysis techniques, evaluating and improving existing BI systems* (see Table 22).

For BA/BDA, the highly ranked unique skill was *applying design thinking.* The remaining unique skills which were never ranked in the top five were *Applying interpersonal skills, building relationships with existing and potential internal customers, review new and existing code to identify areas for improvement*. Finally, in DS, none of the highly ranked unique skills was ranked in the top five. These skills were *Employ data mining skills, using big data concepts, technologies, and tools, analyze data using statistical and platform analytics tools*. Literature states that "Data scientists use advanced analytics tools such as machine learning and predictive analytics (Cao, 2017; Linden, Alaybeyi & Vashisth, 2019).

CHAPTER 5: Conclusion

5.1 Introduction

This research study aimed to identify the specific skills set for BI, BA, BDA, and DS professionals and establish any overlapping skills within them. A qualitative multi-method approach was adopted using online job advertisements and the Delphi method to answer the research questions. This section seeks to summarize findings, recommendations for research, and limitation of the study and future work.

5.2 Summary of findings

What are the key skills required by BI, BA, DS, BDA professionals to perform their jobs effectively?
BI professionals require a plethora of skills to complete their tasks successfully. The research found that there are commonalities between these skills. The commonalities exist in how the skills are applied in practice and how they are defined. During this research, a categorized typology was developed from these commonalities. This categorized typology of top common skills is:

Design and Code (*perform data modelling, apply agile development processes to achieve outstanding data solutions),* **Soft skills** *(communicate effectively, exhibit time management skills, prioritize workload and work well under pressure, demonstrate problem-solving skills, demonstrate excellent analytical skills, be able to work independently, apply creativity and innovation), ,* **Reporting** *(extract insights and trends from data),* **Data manipulation and processing** *(ensure correct data and error handling, formulate validation strategies and methods to ensure accurate and reliable data, manipulate data using SQL, transform data from different sources and load it to extract insights, perform data analysis and validation).* These skills were found to be requisite across the three domains. In addition, this explains that the aforementioned skills are the common skills. The additional skills for these domains were different from each other and were classified as the core skills which will be explained in the next section.

What are organizations' core skills required in BI, BA, DS, and BDA?
This study identified the core skills required for professionals in BI, BA & BDA, and DS space to perform their jobs effectively. For example, in BI, core skills include using *BI/reporting tools (e.g., QlikView, Tableau), working with databases including database design, applying business analysis techniques, and evaluating and improving existing BI systems.* Literature review has highlighted the usage of BI tools as of high importance, "The utilization of BI tools, for example, IBM, Cognos, and Tableau help administrators to plan on the best way to be exceptionally serious in the business condition by distinguishing openings and dangers before their rivals do" (Hans & Mnkandla, 2016). Therefore, the study has validated the use of BI tools and analytics skills. Skills such as *manipulating data using SQL, applying creativity and innovation* extend to the list of top requisite skills for BI professionals.

BA/ BDA core skills have been highlighted as *building relationships with existing and potential internal customers, applying design thinking, reviewing new and existing code to identify areas for improvement, and applying interpersonal skills*. An interesting finding that has surfaced from the study has shown to *apply interpersonal skills* as a core skill within the BA/BDA category. Previous studies have indicated it as a requisite in BI (Kusena & Brown, 2020).
Finally, DS professionals ought to have the specific ability to *use big data concepts, tools, and techniques, analyze data using statistical and platform analytics tools, and employ data mining*

skills. This confirms that DS analyze the data with sophisticated analytical tools and techniques, apply expertise in big data and analytics, apply problem-solving skills, use statistical tools, and machine learning (Mount & Zumel, 2019; Kelleher & Tierney 2018; Mikalef et al., 2017). It further confirms that "Data scientists use advanced analytics tools such as machine learning, predictive analytics", "Data science and computational social science are emerging interdisciplinary fields that overlap in content with big data" (Miller, 2018, P.53).

What are the sub-profiles within BI, BA, DS, and BDA roles?
Research findings indicate that some job titles are common across BA, BDA, and DS. These roles include Data Analyst, Data Architect, and Data Engineer. It has been observed in the data that the aforementioned roles in BA, BDA, and DS are not present in BI. Moreover, BA and BDA are predominantly very similar in their job titles. Similarly, BDA and DS have highlighted some commonalities in them.

5.3 Contributions and Recommendations
This study has shown a plethora of skills in the BI, BA/BDA domain. The study identified the core skills for each category and overlapping skills. Findings have also shown the applicability of the multi-method approach to alleviating biases in the study, which also adds to the study's credibility. Furthermore, the focus of the study is significant to students who want to pursue a career within BI, BA/BDA, and DS as it will assist them in the subjects to take and the type of qualifications they should possess.

5.4 Limitation of the study and Future work
The major limitation in the study is the lack of professionals in the BA/BDA domain to conduct the Delphi method. It was difficult to find professionals within the BA/BDA domain thus it became difficult to satisfy its requirements. This is also evident in the limited number of job ads collected from online Job ads. Findings also reveal a limited number of job ads collected from provinces such as Free State, Limpopo, and Mpumalanga. Other provinces were not represented in the study, such as Northern Cape and Northwest. Future research can investigate why these provinces do not offer jobs within BI and Analytics. Finally, the study was cross-sectional, and data was collected over a period of four months. Future research should consider adopting the longitudinal time frame.

References

Adelzadeh, A. (2017, September). Skills Supply and Demand in South Africa: A 10 Year Forecast. In *2017 International Population Conference*. IUSSP.

Alharthi, A., Krotov, V., & Bowman, M. (2017). Addressing barriers to big data. *Business Horizons*, *60*(3), 285–292.

Attaran, M., & Attaran, S. (2018). The rise of embedded analytics: Empowering manufacturing and service industry with big data. *International Journal of Business Intelligence Research (IJBIR)*, *9*(1), 16–37.

Baghizadeh, Z., Cecez-Kecmanovic, D., & Schlagwein, D. (2020). Review and critique of the information systems development project failure literature: An argument for exploring information systems development project distress. *Journal of Information Technology*, *35*(2), 123–142.

Bayrak, T. (2015). A review of business analytics: A business enabler or another passing fad. *Procedia-Social and Behavioral Sciences*, *195*, 230–239.

Bhattacherjee, A. (2012). *Social science research: Principles, methods, and practices*.
Boell, S. K., & Cecez-Kecmanovic, D. (2014). A hermeneutic approach for conducting literature reviews and literature searches. *Communications of the Association for Information Systems*, *34*(1), 12**.**

Bradbury, D. (2011). Data mining with LinkedIn. *Computer Fraud & Security*, *2011*(10), 5–8.
Brady, S. R. (2015). Utilizing and adapting the Delphi method for use in qualitative research. *International Journal of Qualitative Methods*, *14*(5), 1609406915621381.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101.

Cao, L. (2017). Data science: A comprehensive overview. *ACM Computing Surveys (CSUR)*, *50*(3), 1–42.

Cegielski, C. G., & Jones-Farmer, L. A. (2016). Knowledge, skills, and abilities for entry-level business analytics positions: A multi-method study. *Decision Sciences Journal of Innovative Education*, *14*(1), 91–118.

Chen, H., Chiang, R. H., & Storey, V. C. (2012). Business intelligence and analytics: From big data to big impact. *MIS Quarterly*, 1165–1188.

Coners, A., & Matthies, B. (2014). *A content analysis of content analyses in IS research: Purposes, data sources, and methodological characteristics*.

Costa, C., & Santos, M. Y. (2017). The data scientist profile and its representativeness in the European e-Competence framework and the skills framework for the information age. *International Journal of Information Management*, *37*(6), 726–734.

Cui, Y., Mou, J., Cohen, J., & Liu, Y. (2019). Understanding information system success model and valence framework in sellers' acceptance of cross-border e-commerce: A sequential multi-method approach. *Electronic Commerce Research*, *19*(4), 885–914.

Dawson, L., & Van Belle, J. P. (2013). Critical success factors for business intelligence in the South African financial services sector. *South African Journal of Information Management*, *15*(1), 1-12.

Debortoli, S., Müller, O., & vom Brocke, J. (2014). Comparing business intelligence and big data skills. *Business & Information Systems Engineering*, *6*(5), 289–300.

Dedić, N., & Stanier, C. (2016). Towards differentiating business intelligence, big data, data analytics and knowledge discovery. *International Conference on Enterprise Resource Planning Systems*, 114–122.

Delen, D., & Ram, S. (2018). Research challenges and opportunities in business analytics. *Journal of Business Analytics*, *1*(1), 2–12.

de Jager, T., & Brown, I. (2016). A descriptive categorized typology of requisite skills for business intelligence professionals. *Proceedings of the Annual Conference of the South African Institute of Computer Scientists and Information Technologists*, 1–10.

De Mauro, A., Greco, M., Grimaldi, M., & Ritala, P. (2018). Human resources for Big Data professions: A systematic classification of job roles and required skill sets. *Information Processing & Management*, *54*(5), 807–817.

Demirkan, H., Bess, C., Spohrer, J., Rayes, A., Allen, D., & Moghaddam, Y. (2015). Innovations with smart service systems: analytics, big data, cognitive assistance, and the internet of everything. *Communications of the association for Information Systems*, *37*(1), 35.

Denscombe, M. (2017). *EBOOK: The good research guide: For small-scale social research projects*. McGraw-Hill Education (UK).

Duan, L., & Xiong, Y. (2015). Big data analytics and business analytics. *Journal of Management Analytics*, *2*(1), 1–21.

Elgendy, N., & Elragal, A. (2014). Big data analytics: A literature review paper. *Industrial Conference on Data Mining*, 214–227.

Gaardboe, R., & Svarre, T. (2017). Critical Success factors for Business Intelligence Success. *Proceedings of the 25th European Conference on Information Systems. The Association for Information Systems (AIS)*, 472–486.

Gandomi, A., & Haider, M. (2015). Beyond the hype: Big data concepts, methods, and analytics. *International Journal of Information Management*, *35*(2), 137–144.

Gao, L., & Eldin, N. (2014). Employers' expectations: A probabilistic text mining model. *Procedia Engineering*, *85*, 175–182**.**

Gardiner, A., Aasheim, C., Rutner, P., & Williams, S. (2018). Skill requirements in big data: A content analysis of job advertisements. *Journal of Computer Information Systems*, *58*(4), 374–384.

Grover, V., Chiang, R. H., Liang, T.-P., & Zhang, D. (2018). Creating strategic business value from big data analytics: A research framework. *Journal of Management Information Systems*, *35*(2), 388–423.

Günther, W. A., Mehrizi, M. H. R., Huysman, M., & Feldberg, F. (2017). Debating big data: A literature review on realizing value from big data. *The Journal of Strategic Information Systems*, *26*(3), 191–209

Gupta, B., Goul, M., & Dinter, B. (2015). Business intelligence and big data in higher education: Status of a multi-year model curriculum development effort for business school undergraduates, MS graduates, and MBAs. *Communications of the Association for Information Systems*, *36*(1), 23.

Hans, R. T., & Mnkandla, E. (2016). Work in progress—Design and development of a project management intelligence (PMInt) tool. *2016 International Conference on Advances in Computing and Communication Engineering (ICACCE)*, 308–313.

Hassan, N. R. (2019). The origins of business analytics and implications for the information systems field. *Journal of Business Analytics*, *2*(2), 118–133.

Hattingh, M., Marshall, L., Holmner, M., & Naidoo, R. (2019). Data science competency in organisations: A systematic review and unified model. *Proceedings of the South African Institute of Computer Scientists and Information Technologists 2019*, 1–8.

Jayakrishnan, M. A., Mohamad, A. K. B., & Yusof, M. B. M. (2018). Understanding holistic view and complexities in big data analytics and business intelligence (BI) towards establishing strategic performance management: A case study. *Advanced Science Letters*, *24*(3), 1775-1779.

Kabir, S. M. (2016). Preparing questionnaire. *SM Kabir, Basic Guidelines for Research: An Introductory Approach for All Disciplines*, 181-200.

Kaushik, V., & Walsh, C. A. (2019). Pragmatism as a research paradigm and its implications for social work research. *Social Sciences*, *8*(9), 255.

Keil, M., Lee, H. K., & Deng, T. (2013). Understanding the most critical skills for managing IT projects: A Delphi study of IT project managers. *Information & Management*, *50*(7), 398–414.

Kelleher, J. D., & Tierney, B. (2018). *Data Science*. MIT Press.

Khourdifi, Y., Bahaj, M., & Elalami, A. (2018). A new approach for migration of a relational database into column-oriented NoSQL database on hadoop. *Int. J. Theor. Appl. Inf. Technol. (JATIT)*, *96*(19), 6607–6617.

Kim, M., Zimmermann, T., DeLine, R., & Begel, A. (2016). The emerging role of data scientists on software development teams. *2016 IEEE/ACM 38th International Conference on Software Engineering (ICSE)*, 96–107.

Kirlidog, M., van der Vyver, C., Zeeman, M., & Coetzee, W. (2018). Unfulfilled need: Reasons for insufficient ICT skills in South Africa. *Information Development*, *34*(1), 5–19.

Kotu, V., & Deshpande, B. (2018). *Data science: Concepts and practice*. Morgan Kaufmann.
Kotzé, E. (2017). A survey of data scientists in South Africa. *Annual Conference of the Southern African Computer Lecturers' Association*, 175–191.

Kureková, L. M., Beblavỳ, M., & Thum-Thysen, A. (2015). Using online vacancies and web surveys to analyse the labour market: A methodological inquiry. *IZA Journal of Labor Economics*, *4*(1), 1–20.

Kusena, A., &Brown, I. (2020). Skills Requirements for Business Intelligence Professionals: A Content Analysis of Job Advertisements in South Africa. *Southern African Computer Lecturers' Association.*

Larson, D., & Chang, V. (2016). A review and future direction of agile, business intelligence, analytics, and data science. *International Journal of Information Management*, *36*(5), 700–710.

Liang, T.-P., & Liu, Y.-H. (2018). Research landscape of business intelligence and big data analytics: A bibliometrics study. *Expert Systems with Applications*, *111*, 2–10.

Liebenberg, J., & Gruner, S. (2017). ICT education. *46th Annual Conference of the Southern African Computer Lecturers' Association, SACLA*, 3–5.

Lim, E. P., Chen, H., & Chen, G. (2013). Business intelligence and analytics: Research directions. *ACM Transactions on Management Information Systems (TMIS)*, *3*(4), 1-10.

Linden, A., Alaybeyi, S., & Vashisth, S. (2019). Gartner: Toolkit: Job Description for the Role of Data Scientist for Small/Emerging Teams.

Malaka, I., & Brown, I. (2015). Challenges to the organisational adoption of big data analytics: A case study in the South African telecommunications industry. *Proceedings of the 2015 Annual Research Conference on South African Institute of Computer Scientists and Information Technologists*, 1–9.

Manyika, J., Chui, M., Brown, B., Bughin, J., Dobbs, R., Roxburgh, C., & Hung Byers, A. (2011). *Big data: The next frontier for innovation, competition, and productivity*. McKinsey Global Institute.

Mikalef, P., Framnes, V. A., Danielsen, F., Krogstie, J., & Olsen, D. (2017). Big data analytics capability: antecedents and business value. In *Pacific Asia Conference on Information Systems (PACIS)*. Association for Information Systems.

Miller, G. J. (2018). Quantitative Comparison of Big Data Analytics and Business Intelligence Project Success Factors. In *Information Technology for Management: Emerging Research and Applications*, 346 (4), 53-72

Mills, R. J., Chudoba, K. M., & Olsen, D. H. (2016). IS programs responding to industry demands for data scientists: a comparison between 2011-2016. *Journal of Information Systems Education*, *27*(2), 131.

Mount, J., & Zumel, N. (2019). Practical data science with R. Simon and Schuster.

Murry Jr, J. W., & Hammons, J. O. (1995). Delphi: A versatile methodology for conducting qualitative research. *The review of higher education*, *18*(4), 423-436.

Olszak, C. M. (2016). Toward better understanding and use of Business Intelligence in organizations. *Information Systems Management*, *33*(2), 105-123.

Paré, G., Cameron, A. F., Poba-Nzaou, P., & Templier, M. (2013). A systematic assessment of rigor in information systems ranking-type Delphi studies. *Information & management*, *50*(5), 207-217.

Pedro, J., Brown, I., & Hart, M. (2019). Capabilities and Readiness for Big Data Analytics. *Procedia Computer Science*, *164*, 3–10

Pejic-Bach, M., Bertoncel, T., Meško, M., & Krstić, Ž. (2020). Text mining of industry 4.0 job advertisements. *International Journal of Information Management*, *50*, 416-431.

Phillips-Wren, G., Iyer, L. S., Kulkarni, U., & Ariyachandra, T. (2015). Business analytics in the context of big data: A roadmap for research. *Communications of the Association for Information Systems*, *37*(1), 23.

Power, D. J., Heavin, C., McDermott, J., & Daly, M. (2018). Defining business analytics: an empirical approach. *Journal of Business Analytics*, *1*(1), 40-53.

Provost, F., & Fawcett, T. (2013). Data science and its relationship to big data and data-driven decision making. *Big data*, *1*(1), 51-59. https://doi.org/10.1089/big.2013.1508

Ra, S., Shrestha, U., Khatiwada, S., Yoon, S. W., & Kwon, K. (2019). The rise of technology and impact on skills. *International Journal of Training Research*, *17*(sup1), 26-40.

Rahman, H., Begum, S., & Ahmed, M. U. (2016, October). Ins and outs of big data: A review. In *International Conference on IoT Technologies for HealthCare,* 44-51.
Ram, J., Zhang, C., & Koronios, A. (2016). The implications of big data analytics on business intelligence: A qualitative study in China. *Procedia Computer Science*, *87*, 221-226.

Ransbotham, S., Kiron, D., & Prentice, P. K. (2016). Beyond the hype: the hard work behind analytics success. *MIT Sloan Management Review*, *57*(3).

Rouhani, S., Ashrafi, A., Zare Ravasan, A., & Afshari, S. (2016). The impact model of business intelligence on decision support and organizational benefits. Journal of Enterprise Information Management, 29(1), 19–50. https://doi.org/10.1108/JEIM-12-2014-0126

Saunders, M., Lewis, P., & Thornhill, A. (2009). *Research methods for business students*. Pearson education.

Saunders, M., Lewis, P., & Thornhill, A. (2016). *Research Methods for Business Students* (7th ed.). Harlow: Prentice Hall.

Schmidt, R. C. (1997). Managing Delphi surveys using nonparametric statistical techniques. *decision Sciences*, *28*(3), 763-774.Schoenherr, T., & Speier-Pero, C. (2015). Data science, predictive analytics, and big data in supply chain management: Current state and future potential. *Journal of Business Logistics*, *36*(1), 120-132.

Schoenherr, T., & Speier-Pero, C. (2015). Data science, predictive analytics, and big data in supply chain management: Current state and future potential. *Journal of Business Logistics*, *36*(1), 120-132.

Schüritz, R., Brand, E., Satzger, G., and Kunze von Bischhoffshausen, J. (2017). "How To Cultivate Analytics Capabilities Within an Organization? – Design and Types of Analytics Competency Centers," in *European Conference on Information Systems (ECIS),* Guimarães, Portugal,389–404. https://www.researchgate.net/publication/316672980

Shava, E., & Clementine, M. T. (2016). A descriptive analysis of the causes, challenges, and effects of skills deficit on youth empowerment in South Africa. *Journal of Social Sciences*, *49*(1-2), 93-100.

Sinha, V., & Thaly, P. (2013). A review on changing trend of recruitment practice to enhance the quality of hiring in global organizations. *Management: journal of contemporary management issues*, *18*(2), 141-156.

Singh, J., & Singla, V. (2015). Big data: tools and technologies in big data. *International Journal of Computer Applications*, *112*(15).

Sun, Z., Strang, K., & Firmin, S. (2017). Business analytics-based enterprise information systems. *Journal of Computer Information Systems*, *57*(2), 169-178.

Sutherland, E. (2020). The fourth industrial revolution–the case of South Africa. *Politikon*, *47*(2), 233-252.

Tsai, C.-W., Lai, C.-F., Chao, H.-C., & Vasilakos, A. V. (2016). Big Data Analytics. In *Big Data Technologies and Applications*, 13–52.
Trieu, V.-H. (2017). Getting value from Business Intelligence systems: A review and research agenda. *Decision Support Systems*, *93*, 111–124. https://doi.org/10.1016/j.dss.2016.09.019

Uen, J. F., Ahlstrom, D., Chen, S., & Liu, J. (2015). Employer brand management, organizational prestige, and employees' word-of-mouth referrals in T aiwan. *Asia Pacific Journal of Human Resources*, *53*(1), 104-123.

Vanani, I. R., & Mohammadipour, F. (2019). Big Data Analytics: A Necessary Roadmap for Enterprises. In *Optimizing Big Data Management and Industrial Systems With Intelligent Techniques,* 24-52

van der Aalst, W. (2016). Data Science in Action. *Process Mining*, 3-23. doi: 10.1007/978-3-662-49851-4_1

Vashisth, S., Linden, A., Hare, J., & Krensky, P. (2019). Hype Cycle for Data Science and Machine Learning, 2019. *Gartner Research*.

Verma, A., Yurov, K. M., Lane, P. L., & Yurova, Y. V. (2019). An investigation of skill requirements for business and data analytics positions: A content analysis of job advertisements. *Journal of Education for Business*, *94*(4), 243-250. https://doi.org/10.1080/08832323.2018.1520685

Walker, R. S., & Brown, I. (2019). Big data analytics adoption: A case study in a large South African telecommunications organisation. *South African Journal of Information Management*, *21*(1), 1-10.

Weibl, J., & Hess, T. (2018). Success or failure of big data: Insights of managerial challenges from a technology assimilation perspective. *Proceedings of the Multikonferenz Wirtschaftsinformatik (MKWI)*, 12-59.

Whitelock, V. (2018). Business analytics and firm performance: role of structured financial statement data. *Journal of Business Analytics*, *1*(2), 81-92.

Zide, J., Elman, B., & Shahani-Denning, C. (2014). Linkedin and recruitment: How profiles differ across occupations. *Employee Relations, 36(5),* 583–604. https://doi.org/10.1108/ER-07-2013-0086

Zong, P., Xia, T., Zhao, H., Tong, J., Li, Z., Zhao, W., ... & Ren, P. (2020). PIT: Processing-In-Transmission With Fine-Grained Data Manipulation Networks. *IEEE Transactions on Computers*, *70*(6), 877-891.

APPENDIX 1: ETHICS APPROVAL

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06/11/2020

Adelade Kusena

Department of Information Systems

University of Cape Town
REF: REC 2020/1 1/005
Making sense of Business Intelligence, Business Analytics, Data science, and Big Data
Analytics skills: An analysis of South African professionals

We are pleased to inform you that your ethics application has been approved. Unless otherwise specified this ethical clearance is valid until 30-Nov-2021.

Your clearance may be renewed upon application.

Please be aware that you need to notify the Ethics Committee immediately should any aspect of your study regarding the engagement with participants as approved in this application, change. This may include aspects such as changes to the research design, questionnaires, or choice of participants.

The ongoing ethical conduct throughout the duration of the study remains the responsibility of the principal investigator.

We wish you well for your research.

1.06
+02'00'

Jacques Rousseau

8 July 2021

APPENDIX 2: COVER LETTER

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@Commerce UCT   UCT Commerce Faculty Office

Request to conduct research and participation consent form

Dear Sir/Madam,

In terms of the requirements for completing a master's degree in information systems at the University of Cape Town, a research study is required.

The researcher, in this case Adelade Kusena has chosen to conduct a study entitled *"Making Sense of Business Intelligence, Business Analytics, Data Science, and Big Data Analytics skills in Organisations: An analysis of South African professionals"*. The objectives of the research are to:

- ▪ Identify the requisite skills for Business Intelligence (BI), Business Analytics (BA), Data Science (DS), and Big Data Analytics (BDA) professionals
- ▪ Establish the differences and Similarities in BI, BA, DS and BDA skills
- ▪ Identify the sub-profiles within the roles for BI, BA, DS, and BDA

Your participation in this research is voluntary. All information will be treated in a confidential manner and used exclusively for the purpose of this study. Individual names will be kept

anonymous throughout the research. You will not be requested to supply any identifiable information, ensuring anonymity of your responses. You can choose to withdraw from the research at any time for whatever reason, in accordance with ethical research requirements. Participation will take approximately 30 minutes to complete.

The data collection method will be Sequential multi-method. The first phase will be online job advertisements from five popular job portals in South Africa namely: LinkedIn and indeed. The second phase will be Delphi method (online questionnaires). The (online questionnaires) will be sent via email as per the agreement between the researcher and the participant. If you are willing to participate in this study, kindly sign the attached form and return to me at your earliest convenience.

The findings of the research will be presented in a report to the University of Cape Town. The findings may also be published in an academic journal or in a conference paper if deemed to be of academic value.

Should you have any questions regarding this research, please feel free to contact me on 0605031301 or email: ksnade001@myuct.ac.za

Your participation in this study would be greatly appreciated but is entirely voluntary.

Sincerely,

Adelade Kusena

                               Supervisor Irwin Brown

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APPENDIX 3: PHASE 1 QUESTIONNAIRE

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Making Sense of Business Intelligence, Business Analytics, Data Science, and Big Data
Analytics skills: An analysis of South African Professionals

PHASE 1 QUESTIONNAIRE

The purpose of this study is to identify the requisite skills for Business Intelligence (BI), Business Analytics (BA), Data Science (DS), and Big Data Analytics (BDA) professionals. Participation in this study is voluntary and you may withdraw at any time for whatever reason.

This research has been approved by the UCT's Commerce Faculty Ethics in Research committee (Ethics approval letter Adelade Kusena ksnade001.

Due to the nature of the study, you are required to provide your demographics information. However, all responses will be confidential and used for the purposes of this study only.

This questionnaire will take approximately 15 to 30 minutes to complete. If you have any queries with regard to research, please do not hesitate to contact the researcher, Adelade Kusena at KSNADE001@myuct.ac.za or +27 605031301. Your participation in this study is greatly appreciated.

DEMOGRAPHIC INFORMATION

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DEMOGRAPHIC INFORMATION
- 1.. State, your role in your company

- 2.. What is the highest level of school you have completed or the highest degree you have received?
  - ☐ High school graduate (high school diploma or equivalent including GED)
  - ☐ Some college but no degree
  - ☐ Bachelor's degree (specify Field of study)
  - ☐ Master's degree (specify Field of Study)
  - ☐ Doctoral degree (Specify field of Study)
  - ☐ Professional Certifications

- 3.. What type of Experience do you have? and Specify the years of experience you have in the specific area in the textbox below.
  - ☐ Business Intelligence
  - ☐ Business Analytics
  - ☐ Big Data Analytics
  - ☐ Data Science

- 4.. In which sector do you currently work?
  - ○ Advisory and Consultation
  - ○ Financial Services
  - ○ Health and Medical
  - ○ Information technologies and Services
  - ○ Manufacturing and Construction
  - ○ Marketing and Advertising

- • ⦾ Retail and Consumer goods
- • ⦾ Staffing and Recruitment
- • ⦾ Education
- • ⦾ Other (Please specify) [   ]
- • ..

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Research Questions

Q1. What skills are required for your role to perform your job effectively? (Please provide at least six skills as action-oriented, i.e., begin with a verb such as "translating business strategies into actionable goals" and add a brief description of each.

APPENDIX 4: PHASE 2 QUESTIONNAIRE

Making Sense of Business Intelligence, Business Analytics, Data Science, and Big Data Analytics skills: An analysis of South African Professionals

PHASE 2 QUESTIONNAIRE- Selection of requisite skills for Business Intelligence

The purpose of this study is to identify the requisite skills for Business Intelligence (BI), Business Analytics (BA), Data Science (DS), and Big Data Analytics (BDA) professionals. Participation in this study is voluntary and you may withdraw at any time for whatever reason. This research has been approved by the UCT's Commerce Faculty Ethics in Research committee (Ethics approval letter Adelade Kusena (ksnade001).

The skills have been identified to be requisite for BI & Analytics professionals. These requisite skills were collected from phase 1 (Brainstorming) of the study. Brainstorming phase involves the identification of skills which are considered to be important in the aforementioned domain. The questionnaire will take approximately 15-30 minutes.

Please select *twenty (20)* skills you consider most requisite for Business Intelligence from the list provide
Use BI/reporting tools (e.g., QlikView, Tableau, Apex etc.)

- ☐ Manipulate data using SQL

- ☐ Perform data analysis and validation

- ☐ Transform data from different sources and load it to extract insights (ETL)

- ☐ Create visualizations and Dashboards for reporting

- ☐ Perform data modelling (SQL)

- ☐ Use big data concepts, technologies, and tools

- ☐ Use Cloud technologies (e.g., create data feeds from on-premises to AWS Cloud)

- ☐ Analyze data using statistical and platform analytics tools

- ☐ Communicate effectively, verbally and in writing

- ☐ Demonstrate problem-solving skills

- ☐ Demonstrate excellent analytical skills

- ☐ Apply interpersonal skills

- ☐ Be able to work independently

- ☐ Apply creativity and innovation

- ☐ Deal with conflict situations and exhibit emotional intelligence

- ☐ Develop BI Reports from single and multiple systems

- ☐ Work with databases including database design and developments (e.g. SQL server 2016)

- ☐ Perform business process Management

☐ Code in a variety of programming languages (C, C++, C#, Python, Java,and R)

☐ Review new and existing code to identify areas for improvement

☐ Write software that scales horizontally across commodity hardware

☐ Elicit and document business and user requirements

☐ Perform root cause analysis

☐ Apply business analysis techniques

☐ Design, develop and maintain business intelligence solutions

☐ Employ data mining skills

☐ Prioritize workload and work well under pressure

☐ Configure and use a variety of enterprise and productivity tools

☐ Provide training and coaching

☐ Apply agile development processes to achieve outstanding data solutions

☐ Formulate validation strategies and methods to ensure accurate and reliable data

☐ Ensure correct data and error handling

☐ Provide quick and efficient solutions to data sourcing issues

☐ Manage and cultivate strong client partnerships

☐ Develop data models to inform response programming

☐ Apply project management procedures, tools, techniques etc

☐   Apply managerial skills

☐   Perform financial modelling and analysis

☐   Carry out strategy planning and execution

☐   Stay abreast with the latest developments in the intelligence world. i.e. software and advancements.

☐   Keep informed of current data protection and privacy laws of the global economies to serve data in a safe manner

☐   Determine appropriate technology solutions for the businesses

☐   Implement and enforce an effective testing strategy with the relevant accompanying processes

☐   Ensure product quality is built in before product is released

☐   Evaluate and improve existing BI systems

☐   Collaborate within multi-disciplinary teams to integrate systems

☐   Exhibit time management skills

☐   Demonstrate a high level of trust and self-discipline

☐   Define solutions for user facing websites and systems

☐   Adapt to rapidly evolving priorities in a highly technical and fast-paced environment

☐   Comprehend the IT landscape to ensure that solutions designed are not in conflict with the IT architecture

☐   Apply design thinking

- ☐ Perform capability mapping in the context of business architecture

- ☐ Employ Systems Development Life Cycles (SDLCs)

- ☐ Carry out architecture changes, infrastructure, and implementation of new components

- ☐ Work with security design principles

- ☐ Employ use cases

- ☐ Apply Artificial Intelligence

- ☐ Use version-control systems

- ☐ Carry out BI scripting and end-user design

- ☐ Handle clients professionally during all interactions

- ☐ Build relationships with existing and potential internal customers to understand their individual requirements and demonstrate how products can add value to their business

- ☐ Work with data profiling

- ☐ Use Object-oriented design, data structures and algorithms

- ☐ Stream data

- ☐ Apply technical and strategic mindfulness to be able to develop and implement new BI systems and processes

- ☐ Employ digital experience monitoring or end-user experience driven functions

- ☐ Extract insights and trends from data

- ☐ Perform Robotics Process Automation (RPA)

☐   Build real time systems that integrate with the rest of the stack

☐   Work with software developers and solution designers to deliver analytics-driven solutions

☐   Make development changes and understand system architecture

☐   Apply forecasting techniques

☐   Apply data science skills in complex environments to support customer facing and/or corporate processes

☐   Define the data technology roadmap as part of a cross functional team

☐   Apply ensemble learning like Boosting/Bagging, Neural Networks
Use data science tools/packages

APPENDIX 5: PHASE 3-1ST ROUND QUESTIONNAIRE

RANKING OF REQUISITE BUSINESS INTELLIGENCE SKILLS PHASE 3 - 1st Round Questionnaire
The ranking phase involves the ranking of each requisite skill in order of its important (1 to 20), with "1" being the most important, and '20" being the least important. This questionnaire will take approximately 15-30 minutes.

INSTRUCTIONS
Carefully read the instructions before clicking the "Next" button.
1.Please click the "Next" button and proceed to rank the Business intelligence skills you consider to be most requisite.
2.Please rank the top 20 out of 37 skills based on their level of importance Please rank each Business intelligence skill by dragging the skill to a position in order of its importance relative to other Business intelligence skills ("Position" 1 = most important" and "Position 20 = least important")
3.Submit the survey when completed.

Please rank the top 20 out of 37 skills based on their level of importance ("Position" 1 = most important" and "Position 20 = least important")

- Manipulate data using SQL

- Transform data from different sources and load it to extract insights (ETL)

- Perform data analysis and validation

- Perform data modelling (SQL)

- Use BI/reporting tools (e.g. QlikView, Tableau, Apex etc)

- Create visualizations and Dashboards for reporting

- Prioritize workload and work well under pressure

- Communicate effectively, verbally and in writing

- Ensure correct data and error handling

- Apply agile development processes to achieve outstanding data solutions

- Exhibit time management skills

- Demonstrate problem-solving skills

- Be able to work independently

- Formulate validation strategies and methods to ensure accurate and reliable data

- Extract insights and trends from data

- Demonstrate excellent analytical skills

- Apply creativity and innovation

- Code in a variety of programming languages (C, C++, C#, Python, Java,and R)

- Work with databases including database design and developments (e.g. SQL server 2016)

- Apply business analysis techniques

- Review new and existing code to identify areas for improvement

- Use big data concepts, technologies, and tools

- Apply interpersonal skills

- Develop data models to inform response programming

- Analyze data using statistical and platform analytics tools

- Develop BI Reports from single and multiple systems

- Evaluate and improve existing BI systems

- Employ use cases

- Apply forecasting techniques

- Use Cloud technologies (e.g., create data feeds from on-premises to AWS Cloud)

- Employ data mining skills

- Provide quick and efficient solutions to data sourcing issues

- Stay abreast with the latest developments in the intelligence world. i.e., software and advancements.

- Apply design thinking

- Build relationships with existing and potential internal customers to understand their individual requirements and demonstrate how products can add value to their business

- Stream data

- Work with software developers and solution designers to deliver analytics-driven solutions

Please provide a brief explanation of the reasoning behind the top five ranked skills

APPENDIX 6: PHASE 3-2ND ROUND_BI QUESTIONNAIRE

RANKING OF REQUISITE BUSINESS INTELLIGENCE SKILLS

PHASE 3 - 2nd Round Questionnaire

The ranking phase involves the ranking of each requisite skill in order of its important (1 to 20), with "1" being the most important, and '20" being the least important. This questionnaire will take approximately 10-15 minutes.

INSTRUCTIONS

Carefully read the instructions below before you proceed for ranking.
1. Please rank **ALL** skills based on their level of importance.
2. Please rank each Business intelligence skill by **dragging** the skill to a position in order of its importance relative to other Business intelligence skills ("Position" 1 = most important" and "Position 20 = least important").
3. Submit the survey when completed by clicking the arrow at the bottom right corner.

Please rank <u>ALL</u> skills based on their level of importance ("Position" 1 = most important" and "Position 20 = least important")

- Manipulate data using SQL
- Use BI/reporting tools (e.g., QlikView, Tableau, Apex etc)
- Transform data from different sources and load it to extract insights (ETL)
- Perform data modelling (SQL)
- Communicate effectively, verbally and in writing
- Create visualizations and Dashboards for reporting
- Perform data analysis and validation
- Exhibit time management skills
- Ensure correct data and error handling
- Prioritize workload and work well under pressure
- Extract insights and trends from data
- Demonstrate problem-solving skills
- Formulate validation strategies and methods to ensure accurate and reliable data
- Apply agile development processes to achieve outstanding data solutions
- Be able to work independently
- Work with databases including database design and developments (e.g. SQL server 2016)
- Apply creativity and innovation
- Demonstrate excellent analytical skills
- Apply business analysis techniques
- Evaluate and improve existing BI systems

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APPENDIX 7: PHASE 3-2ND ROUND_BA&BDA QUESTIONNAIRE

RANKING OF REQUISITE BUSINESS ANALYTICS SKILLS

PHASE 3 - 2nd Round Questionnaire

The ranking phase involves the ranking of each requisite skill in order of its important (1 to 20), with "1" being the most important, and '20" being the least important. This questionnaire will take approximately 10-15 minutes.

INSTRUCTIONS

Carefully read the instructions and proceed to rank the Business analytics skills you consider to be most requisite.

1. Please rank **ALL** skills based on their level of importance
2. Please rank each Business analytics skill by dragging the skill to a position in order of its importance relative to other Business analytics skills ("Position" 1 = most important" and "Position 20 = least important")
3. Submit the survey when completed.by clicking the arrow at the bottom right corner

Please rank ALL skills based on their level of importance ("Position" 1 = most important" and "Position 20 = least important")

- Communicate effectively, verbally and in writing

- Demonstrate problem-solving skills

- Perform data analysis and validation

- Transform data from different sources and load it to extract insights (ETL)

- Ensure correct data and error handling

- Prioritize workload and work well under pressure

- Apply agile development processes to achieve outstanding data solutions

- Apply creativity and innovation

- Perform data modelling (SQL)

- Manipulate data using SQL

- Demonstrate excellent analytical skills

- Exhibit time management skills

- Formulate validation strategies and methods to ensure accurate and reliable data

- Build relationships with existing and potential internal customers to understand their individual requirements and demonstrate how products can add value to their business

- Extract insights and trends from data

- Be able to work independently

- Apply design thinking

- Code in a variety of programming languages (C, C++, C#, Python, Java,and R)

- Review new and existing code to identify areas for improvement

- Apply interpersonal skills

APPENDIX 8: PHASE 3-2ND ROUND BDA- QUESTIONNAIRE

RANKING OF REQUISITE BIG DATA ANALYTICS SKILLS

PHASE 3 - 2nd Round Questionnaire

The ranking phase involves the ranking of each requisite skill in order of its important (1 to 20), with "1" being the most important, and '20" being the least important. This questionnaire will take approximately 10-15 minutes.

INSTRUCTIONS

Carefully read the instructions and proceed to rank the Big Data Analytics skills you consider to be most requisite.

1. Please rank **ALL** skills based on their level of importance
2. Please rank each Big Data Analytics skill by dragging the skill to a position in order of its importance relative to other Big Data Analytics skills ("Position" 1 = most important" and "Position 20 = least important")
3. Submit the survey when completed by clicking the arrow at the bottom right corner.

Please rank ALL skills based on their level of importance ("Position" 1 = most important" and "Position 20 = least important")

- Communicate effectively, verbally and in writing

- Demonstrate problem-solving skills

- Perform data analysis and validation

- Transform data from different sources and load it to extract insights (ETL)
- Ensure correct data and error handling
- Prioritize workload and work well under pressure
- Apply agile development processes to achieve outstanding data solutions
- Apply creativity and innovation
- Perform data modelling (SQL)
- Manipulate data using SQL
- Demonstrate excellent analytical skills
- Exhibit time management skills
- Formulate validation strategies and methods to ensure accurate and reliable data
- Build relationships with existing and potential internal customers to understand their individual requirements and demonstrate how products can add value to their business
- Extract insights and trends from data
- Be able to work independently
- Apply design thinking
- Code in a variety of programming languages (C, C++, C#, Python, Java,and R)
- Review new and existing code to identify areas for improvement
- 20 Apply interpersonal skills

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APPENDIX 9: PHASE 3- 2ND ROUND_DS QUESTIONNAIRE

RANKING OF REQUISITE DATA SCIENCE SKILLS

PHASE 3 - 2nd Round Questionnaire

The ranking phase involves the ranking of each requisite skill in order of its important (1 to 20), with "1" being the most important, and '20" being the least important. This questionnaire will take approximately 10-15 minutes.

INSTRUCTIONS

Carefully read the instructions and proceed to rank the Data Science skills you consider to be most requisite.
1. Please rank **ALL** skills based on their level of importance
2. Please rank each Data Science skill by dragging the skill to a position in order of its importance relative to other Data Science skills ("Position" 1 = most important" and "Position 20 = least important")
3. Submit the survey when completed by clicking the arrow at the bottom right corner.

Please rank ALL skills based on their level of importance ("Position" 1 = most important" and "Position 20 = least important")

- Perform data analysis and validation
- Transform data from different sources and load it to extract insights (ETL)
- Code in a variety of programming languages (C, C++, C#, Python, Java,and R)
- Create visualizations and Dashboards for reporting
- Demonstrate problem-solving skills
- Extract insights and trends from data
- Prioritize workload and work well under pressure
- Communicate effectively, verbally and in writing
- Ensure correct data and error handling
- Demonstrate excellent analytical skills
- Manipulate data using SQL
- Formulate validation strategies and methods to ensure accurate and reliable data
- Be able to work independently
- Apply creativity and innovation

- Apply agile development processes to achieve outstanding data solutions
- Exhibit time management skills
- Use big data concepts, technologies, and tools
- Analyze data using statistical and platform analytics tools
- Perform data modelling (SQL)
- Employ data mining skills

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APPENDIX 10: PHASE 3-3RD ROUND-BI QUESTIONNAIRE

Please rank <u>ALL</u> skills based on their level of importance ("Position" 1 = most important" and "Position 20 = least important")

- Manipulate data using SQL
- Use BI/reporting tools (e.g., QlikView, Tableau, Apex etc.)
- Transform data from different sources and load it to extract insights (ETL)
- Perform data modelling (SQL)
- Communicate effectively, verbally and in writing
- Create visualizations and Dashboards for reporting
- Perform data analysis and validation
- Exhibit time management skills
- Ensure correct data and error handling
- Prioritize workload and work well under pressure
- Extract insights and trends from data
- Demonstrate problem-solving skills
- Formulate validation strategies and methods to ensure accurate and reliable data
- Apply agile development processes to achieve outstanding data solutions
- Be able to work independently
- Work with databases including database design and developments (e.g., SQL server 2016)
- Apply creativity and innovation
- Demonstrate excellent analytical skills
- Apply business analysis techniques
- Evaluate and improve existing BI systems

APPENDIX 11: PHASE 3-3RD ROUND BA&BDA- QUESTIONNAIRE

Please rank <u>ALL</u> skills based on their level of importance ("Position" 1 = most important" and "Position 20 = least important")

- Manipulate data using SQL

- Use BI/reporting tools (e.g., QlikView, Tableau, Apex etc.)

- Transform data from different sources and load it to extract insights (ETL)

- Perform data modelling (SQL)

- Communicate effectively, verbally and in writing

- Create visualizations and Dashboards for reporting

- Perform data analysis and validation

- Exhibit time management skills

- Ensure correct data and error handling

- Prioritize workload and work well under pressure

- Extract insights and trends from data

- Demonstrate problem-solving skills

- Formulate validation strategies and methods to ensure accurate and reliable data

- Apply agile development processes to achieve outstanding data solutions

- Be able to work independently

- Work with databases including database design and developments (e.g., SQL server 2016)

- Apply creativity and innovation

- Demonstrate excellent analytical skills

- Apply business analysis techniques

- Evaluate and improve existing BI systems

APPENDIX 12: PHASE 3 3RD ROUND BDA QUESTIONNAIRE

RANKING OF REQUISITE BIG DATA ANALYTICS SKILLS

PHASE 3 - 3rd Round Questionnaire

The ranking phase involves the ranking of each requisite skill in order of its important (1 to 20), with "1" being the most important, and '20" being the least important. The rank order below represents the aggregate of the previous round's ranking. This questionnaire will take approximately 10-15 minutes.

INSTRUCTIONS

Carefully read the instructions and proceed to rank the Big Data Analytics skills you consider to be most requisite.

1. Please rank **ALL** skills based on their level of importance
2. Please rank each Big Data Analytics skill by dragging the skill to a position in order of its importance relative to other Big Data Analytics skills ("Position" 1 = most important" and "Position 20 = least important")
3. Submit the survey when completed by clicking the arrow at the bottom right corner.

Please rank ALL skills based on their level of importance ("Position" 1 = most important" and "Position 20 = least important")

- Communicate effectively, verbally and in writing
- Demonstrate problem-solving skills
- Perform data analysis and validation
- Transform data from different sources and load it to extract insights (ETL)
- Ensure correct data and error handling
- Prioritize workload and work well under pressure
- Apply agile development processes to achieve outstanding data solutions
- Apply creativity and innovation
- Perform data modelling (SQL)
- Manipulate data using SQL
- Demonstrate excellent analytical skills
- Exhibit time management skills
- Formulate validation strategies and methods to ensure accurate and reliable data

- Build relationships with existing and potential internal customers to understand their individual requirements and demonstrate how products can add value to their business

- Extract insights and trends from data

- Be able to work independently

- Apply design thinking

- Code in a variety of programming languages (C, C++, C#, Python, Java,and R)

- Review new and existing code to identify areas for improvement

- Apply interpersonal skills

Please provide a brief explanation of the reasoning behind the top ranked skill

APPENDIX 13-PHASE 3 3RD ROUND DS-QUESTIONNAIRE

RANKING OF REQUISITE DATA SCIENCE SKILLS

PHASE 3 - 3rd Round Questionnaire

The ranking phase involves the ranking of each requisite skill in order of its important (1 to 20), with "1" being the most important, and '20" being the least important. The rank order below represents the aggregate of the previous round's ranking. This questionnaire will take approximately 10-15 minutes.

INSTRUCTIONS

Carefully read the instructions and proceed to rank the Data Science skills you consider to be most requisite.
1. Please rank **ALL** skills based on their level of importance
2. Please rank each Data Science skill by dragging the skill to a position in order of its importance relative to other Data Science skills ("Position" 1 = most important" and "Position 20 = least important")
3. When completed, submit the survey by clicking the arrow at the bottom right corner.

Please rank <u>ALL</u> skills based on their level of importance ("Position" 1 = most important" and "Position 20 = least important")

- Perform data analysis and validation
- Transform data from different sources and load it to extract insights (ETL)
- Code in a variety of programming languages (C, C++, C#, Python, Java,and R)
- Create visualizations and Dashboards for reporting
- Demonstrate problem-solving skills
- Extract insights and trends from data
- Prioritize workload and work well under pressure
- Communicate effectively, verbally and in writing
- Ensure correct data and error handling
- Demonstrate excellent analytical skills
- Manipulate data using SQL
- Formulate validation strategies and methods to ensure accurate and reliable data
- Be able to work independently
- Apply creativity and innovation
- Apply agile development processes to achieve outstanding data solutions
- Exhibit time management skills
- Use big data concepts, technologies, and tools
- Analyze data using statistical and platform analytics tools
- Perform data modelling (SQL)
- Employ data mining skills

Please provide a brief explanation of the reasoning behind the top-ranked skill

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APPENDIX 14: TABLE OF SKILLS CONSOLIDATION PROCESS

Defined Skill	Raw Data	Sources
Apply creativity and innovation	" Creativity and innovating", "Creative thinking skills", "Self-starter and ability to work under own initiative", "Capable of managing concurrent initiatives"	Job Ads
Deal with conflict situations and exhibit Emotional intelligence	"Ability to effectively deal with conflict situations and Emotional intelligence"	Job Ads
Review new and existing code to identify areas for improvement	"Review new and existing code to identify areas for improvement", "Ability to interpret code and support applications", " Code reviews"	Job Ads
Evaluate and improve existing BI systems	" Evaluate and improve existing BI systems, "collaborate with teams to integrate systems"	Job Ads
Collaborate within multi-disciplinary teams to integrate systems	""Ability to work across multi-disciplined teams", " Ability to collaborate effectively and work as part of a team as well as on your own",	Job Ads
Exhibit Time management skills	"Time management skills", "Ability to manage competing priorities with stringent timelines"	Job Ads
Demonstrate a high level of trust and self-discipline	"Able to demonstrate a high level of trust and self-discipline"	Job Ads
Define solutions for user facing websites and systems	"Defining solutions for user facing websites and systems"	Job Ads
Adapt to rapidly evolving priorities in a highly technical and fast-paced environment	" Ability to adapt to rapidly evolving priorities in a highly technical and fast-paced environment"	Job Ads
Comprehend the IT landscape to ensure that solutions designed are not in conflict with the IT architecture	"Understanding the IT landscape to ensure that solutions designed are not in conflict with the IT architecture", "Understanding IT dependencies and interdependencies, ensuring that the end-to-end business value chain is not compromised"	Job Ads
Apply Design thinking	"Understanding of Design thinking"	Job Ads
Perform capability mapping in the context of Business Architecture	"Proficient in understand capability mapping in the context of Business Architecture"	Job Ads
Employ Systems Development Life Cycles (SDLCs	"Understanding of Systems Development Life Cycles (SDLCs)"	Job Ads
Carry out Architecture changes, infrastructure, and implementation of new components	"Architecture changes, infrastructure and implementation of new components"	Job Ads
Employ use cases	"Familiarity with the use cases"	Job Ads
Apply Artificial Intelligence (AI)	"Artificial Intelligence (AI) (will be an added advantage)"	Job Ads
Define solutions for user facing websites and systems	"Defining solutions for user facing websites and systems"	Job Ads
Use version-control systems	"Familiarity with version-control systems"	Job Ads
Carry out BI scripting and end-user design	" Cognos scripting and end-user design", "VB Scripting"	Job Ads
Handle clients professionally during all interactions	"Ability to handle clients professionally during all interactions", " Ability to interact with users and provide training for systems"	Job Ads
Build relationships with existing and potential internal customers to understand their individual requirements and demonstrate how products can add value to their business	"Build relationships with existing and potential internal customers to understand their individual requirements and demonstrate how products can add value to their business", "Building relationships", "Ability to handle clients professionally during all interactions", " Ability to interact with users and provide training for systems", "Ability to build rapport and credibility with stakeholders"	Job Ads
Work with data profiling	"Ability to work with data profiling"	Job Ads
Use Object-oriented design, data structures and algorithms	"Object-oriented design, data structures and algorithms"	Job Ads

Stream data	" Streaming data"	Job Ads
Apply Technical and strategic mindfulness to be able to develop and implement new BI systems and processes	"Technical and strategic mindfulness to be able to develop and implement new BI systems and processes", "Critical thinking under pressure"	Job Ads
Employ Digital Experience Monitoring or end-user experience driven functions	"Digital Experience Monitoring or similar end-user experience driven functions"	Job Ads
Extract insights and trends from data	"Descriptive analytics (ability to extract insights and trends from data)", "Ability to extract insights and trends from data based on requirements", "Transform both structured and unstructured data into insights", "Strong curiosity to sift through data to find answers and more insights"	Job Ads
Perform Robotics Process Automation (RPA)	Robotics Process Automation (RPA)	Job Ads
Work with software developers and solution designers to deliver analytics-driven solutions	"Work with software developers and solution designers to deliver analytics-driven solutions"	Job Ads
Make development changes and understand system architecture	"Ability to make development changes and understand system architecture"	Job Ads
Apply forecasting techniques	"Knowledge of forecasting techniques"	Job Ads
Define the data technology roadmap as part of a cross functional team	"Technical leadership skills to be able to define the data technology roadmap as part of a cross functional team", "Developing a roadmap and functional specifications"	Job Ads
Apply Ensemble learning like Boosting/Bagging, Neural Networks	"Ensemble learning like Boosting/Bagging, Neural Networks "	Job Ads
Use Data science tools/packages (Python, R, XGBoost, TensorFlow, NLTK)	"Data science tools/packages: Python, R, XGBoost, TensorFlow, NLTK"	Job Ads
Research and provide alternative approaches to supervisory tools for effective risk management	"Research and provide alternative approaches to supervisory tools for effective risk management", "Willingness to undertake assignments involving unfamiliar subjects", "Research Skills"	Job Ads, Literature Review
Apply interpersonal skills	"Exceptional interpersonal skills, including teamwork, facilitation and negotiation", "Interpersonal skills (Interaction with different business divisions and level of management)", "Strong Negotiating skills", "Apply interpersonal skills"	Job Ads, Literature Review
Be able to work independently	"Able to work independently but also as part of a team working towards a collective outcome, "working within a Wintel team+C106m or similar"", " Work independently"	Job Ads, Literature Review
Work with security design principles	"Working with security design principles", "Apply design principles to the development of BI solutions"	Job Ads, Literature Review
Perform data analysis and validation	"Data analysis and validation of the results of analysis"	Survey
Formulate validation strategies and methods to ensure accurate and reliable data	"Formulating validation strategies and methods (i.e., system edits, reports, and audits) to ensure accurate and reliable data"	survey
Provide quick and efficient solutions to data sourcing issues	"Providing quick and efficient solutions to data sourcing issues", Monitor and evaluate changes and updates to source production systems	survey
Stay abreast with the latest developments in the intelligence world. i.e. software and advancements.	"Stay abreast with the latest developments in the intelligence world. i.e. Software and advancements", "Interest in technology and how to use technology"	survey
Keep informed with respect to latest data protection acts of the global economies to serve data in a safe manner	"Keep informed with respect to latest data protection acts of the global economies to serve data in a safe manner"	survey

Write software that scales horizontally across commodity hardware	"Writing software that can scale to millions of records processed per second - The amount of data we process will only increase - you need to be able to scale to this by writing software that scales horizontally across commodity hardware"	**survey**
Determine appropriate technology solutions for the businesses	"Determining appropriate technology solutions for the businesses' analytic requirements - Choosing the correct architecture and datastore for a business intelligence workload, this includes meeting with third party vendors and benchmarking available solutions.", "Migrating legacy systems to modern technology - ETL has matured over the years and moved from batch to streaming resulting in more real time data"	**survey**
Use BI/reporting tools (Qlik, Tableu, Apex etc)	"You need experience with BI tools, can be power BI Qlik or tableau", "QlikView for Data modelling and Report building", " Experience using a BI reporting tool (e.g. QlikView, Tableau, Microsoft Power BI, Looker, etc.)", "BI development, PL/SQL or T-SQL scripting", "Data Analysis, Data reconciliation, Oracle BI or Power BI or Tableau or Qlik View/Sense, SQL,QlikView, QlikSense, SSRS, VB Scripting", "Familiar with Tableau or similar data visualization tools (Power BI, Qlik, MicroStrategy, etc.)", "Experience with any BI development application tool including Qlikview, PowerBI and SQL, Excel", "Knowledge in technology such as Power BI, MEANStack, QlikView/QlikSense or Tableau", "Experience using a BI reporting tool (e.g. QlikView, Tableau, Microsoft Power BI, Looker, etc.", "Knowledge of business intelligence tools, like Siemens XHQ (training will be provided by Siemens)," Business Intelligence Reporting - Tableau or QlikView, QlikView, QlikSense, Nprinting, Oracle (SQL), Technical experience in either APEX, Tableau or PowerBI desirable, Proficient in at least one other BI toolset (Qlikview, Microstrategy, Business Objects, Tableau, Cognos etc, High level of proficiency using Business Intelligence products, such as Microsoft Power BI and Qlik, Familiar with Tableau or similar data visualization tools (Power BI, Qlik, MicroStrategy, etc.), BI Tools (Sisense, Qlickview, Microsoft Power BI etc.), Microsoft SQL / PostGreSQL, SQL Server Reporting Services (SSRS/BIDS)", "SSRS", "Reporting tools: SAS, Power BI, SSRS, Excel, OBIEE"	**Survey, Job Ads**
Use Big data technologies and tools	"Administration of the Hadoop infrastructure and environment", "Experience using Looker, Big Query and Data form", "Big data tools: Hadoop, Spark, Kafka, Data Bricks"ration of the Hadoop infrastructure and environment", "Ability to extract big data to conform to the needs of the client/sponsor ", "Big data concepts Programming (java, Scala, python)", "BIG DATA cloud solutions", " Big data tools: Hadoop, Spark, Kafka, Data Bricks", "Apply expertise in big data and analytics", "Experience using Looker, BigQuery and Dataform", "Big data tools: Hadoop, Spark, Kafka, Data Bricks", ""Integrate big data solutions with existing reporting and analytical solutions", "Design, develop and implement big data models and solutions", "Understanding of Big Data Technologies - Hadoop (Cloudera Stack preferred) including Map-Reduce, HDFS and Hbase","Experience building and optimizing big data data pipelines", "implementation of creative data solutions leveraging the latest in Big Data frameworks", "Proficient understanding of underlying infrastructure for Big Data Solutions (Clustered/Distributed Computing", "Understand leading edge technologies and best practice around Big Data platforms", "Experience working in Big data environment (advantageous for all, a must for high volume environments) – optimising and building big data pipelines", "Make sense of messy data","Use multiple technologies"	**Survey, Job Ads**

Use Cloud technologies (e.g create data feeds from on-premises to AWS cloud)	"Cloud technology like Data form for Migration", "Cloud Analytics (AWS and AZURE)", "Cloud Analytics", "Working knowledge of cloud infrastructure", " AWS cloud services: EC2, EMR, RDS, Redshift, Aurora, S3", "Experience working with Cloud BI solutions like AWS RDS, or Azure", "Experience with Azure cloud", "Have experience with Google Cloud, or another cloud provider (architecture, operations)", "Use to modern data platform technologies that support cloud", "Good knowledge of Azure Cloud BI stack"	survey, Job Ads
Develop BI Reports from single and multiple systems	"Registering reporting specs", "automating reports", "Development of reports from single and multiple systems", "Ability to build parameterized reports, create subscriptions and schedules, expressions, sub reports, etc.)", "Business writing skills", " Drafting of professional presentations and reports"	Survey, Job Ads
Work with Databases including database design and developments (SQL server 2016)	"Connecting to DB" , "Working with databases", ", SQL Server 2016", " SYBASE", "Oracle SQL developer", "Data warehousing", "Database design and development System analysis ", "Database / Data repository design", "Strong database design skills", "Experience with DBA case tools (frontend/backend) and third-party tool", "Crafting and executing queries upon request for data", "Develop and execute database queries and conduct analyses", "Data warehouse design", "Thorough understanding of relational databases and relational concepts", "90. MSSQL experience with specific reference to creation of stored procedures", "Developing Star Schemas and Multidimensional models according to the Ralph Kimball design principals", "Strong database development skills, including sound SQL skills", " Working with multi-dimensional cubes", "Performance tuning, Query optimisation", "Integration of new data into data warehouse", "Supporting database building requirements, metadata, backup procedures, and process documentation", MSSQL experience with specific reference to creation of stored procedures, functions, automation of jobs, performance tuning and optimization"	survey, Job Ads
Perform root cause analysis	"Root cause analysis skills", "Conduct root cause analysis on issues", "Identify root causes and recommend solutions", "Proven ability to perform root cause analysis, In depth knowledge and competency on the system is necessary for problem solving and root cause analysis", "Experience performing root cause analysis on internal and external data and processes to answer specific business questions and identify opportunities for improvement"	survey, Job Ads
Prioritize workload and work well under pressure	"Ability to prioritize and function positively under pressure", "Ability to prioritise workload and work well under pressure"	survey, Job Ads
Apply agile development processes to achieve outstanding data solutions	"Flexibility - ability to know agile systems/software that help you to work effectively with big datasets", "Applying standard methodologies, and tracking to operational metrics ", "Deliver services according to project plans and architectural and governance mechanisms to ensure overall compliance and improved service delivery", "Experience with the Agile Methodology", "Apply an Agile delivery process to the evolutionary creation of value from data", "Leading agile product teams to achieve outstanding data solutions", "experience with agile scrum, scrum master role, sprint planning, managing product backlogs", "Managing product backlogs"	survey, Job Ads
Ensure correct Data and Error handling	"Changes to source data, process errors, verifying suspect data", "Handling of data, ensuring that data collected is proofed to source", "Error handling"	survey, Job Ads
Manage and cultivate strong client partnerships	"Overall management of dataset additional process", "Demonstrated success managing and cultivating strong client	survey, Job Ads

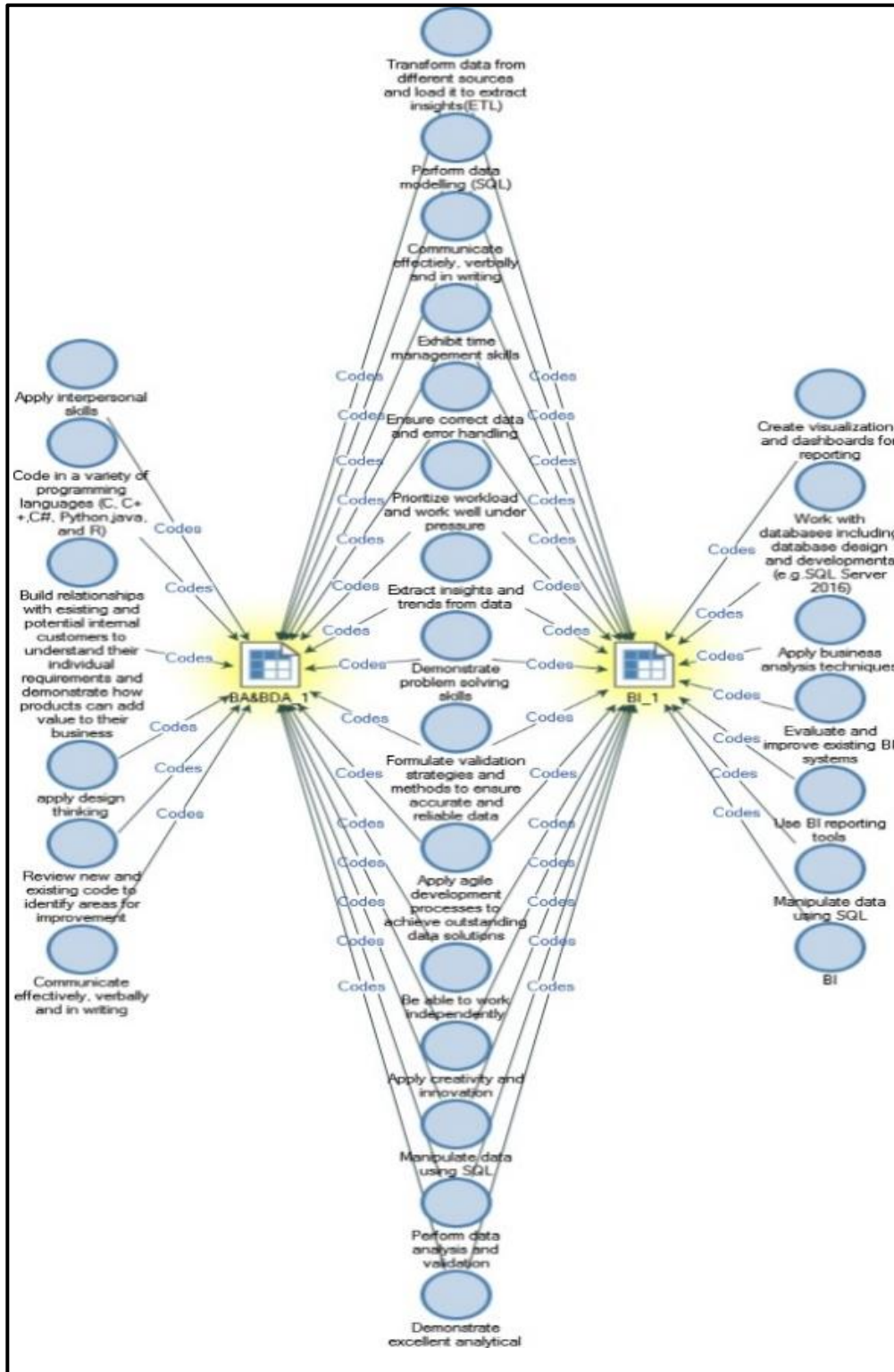|	partnerships, Handle clients professionally during all interactions	
Develop data models to inform response programming	"Developing data models in displacement trends and human movement to inform response programming", "Developing data models and algorithms to apply to data sets"	survey, Job Ads
Perform Financial modelling and analysis	"Financial modelling and analysis", "Basic financial knowledge and understanding"	survey, Job Ads
Implement and enforce an effective testing strategy with the relevant accompanying processes	"Implement and enforce an effective testing strategy with the relevant accompanying processes", "Conducting integrity tests"	Survey, Job Ads
Ensure product quality is built in before product is released	"Ability to ensure product quality is built in before product is released", "Provision of quality assurance of imported data"	Survey, Job Ads
Apply data science skills in complex environments to support customer facing and/or corporate processes	" Applied data science skills in complex environments to support customer facing and/or corporate processes", " Implementation skills for data technology and automation of the data science workflow", "Data Engineering", "Ability to align theoretical data science skills with real world business problems", "Data Science python libraries", Apply Data Wrangling to transform big data to conform to the needs of the client/sponsor	Survey, Job Ads
Manipulate data using SQL	"You need to have experience with SQL in order to manipulate the data, proficient in SQL and PL/SQL, SQL Server 2016, Oracle SQL developer, Strong SQL experience is non-negotiable, Extensive use of SQL and RDBMS systems, RDBMS, understanding of SQL queries, experienced in using SQL Developer for Oracle", "SQL Server 2016, SSIS, SSRS, SSAS, QlikView"	survey, Job Ads, Literature Review
Transform data from different sources and load it to extract insights (ETL)	"You need to be able to perform data interfration (ETL)" , "Data Transformation" ,"Extracting, Loading and Transforming data", , "Assisting with management of data, including extraction, transformation, and loading (ETL) resorting Analysing trend, correlations etc to discover insights that drive business", "Integration and interpretation of data from internal or external sources in preparation for analysis and reporting", "Creation of complex ETL (Extract, Transform, Load) processes", "loading data from various data sources", "extractions, transformations, loading patterns)",, " Manage data from different data sources", "Knowledge of ETL and data analysis with focus on data integrity, Sound knowledge of ETL, Sound knowledge of ETL, SSIS (creation of complex ETL (Extract, Transform, Load) processes, ETL processes to create data marts, to including data quality checks, Data Staging and ETL Development", "Data Staging and ETL Development", " Data Migrations", "Proficient in ETL programming"	survey, Job Ads, Literature Review
Create visualizations and Dashboards for reporting	"QlikView for Data modelling and Report building", "plotting over a date dimension", "Data visualisation skills", "Managing and designing the reporting environment, including data sources, security, and metadata", "Data visualization", Managing and designing the reporting environment, including data sources, security, and metadata, Presenting information through reports and visualization, Experience in visualization tools including Power Business Intelligence (BI) or Tableau, Data analysis, visualization and reporting, Experience in working with data visualization tools (Cognos or PowerBI preferred), Advanced skills in Excel as well as any data visualization tools like Tableau/Quick Sight , Exposure to Data visualization tools (Cognos, Tableau, PowerBI etc.), report building and visualization, Power BI or any other visualization tool, QlikView/QilkSense or other dashboard tools for data visualization, Knowledge of developing visualization tools (e.g. Power BI, SAC, Tableau), Management reporting, Strong knowledge of and experience with reporting packages (Business Objects etc), Develop and automate reporting of key	survey, Job Ads, Literature Review

	performance indicators of various products and services at scale, Understand the data requirements of front-end (reporting, dashboarding and analysis tools.)", " "Incorporate new changes in BI reports", "Extract data", " Identify business improvements based on the data", "Generate static and dynamic visualizations in a variety of visual media", designing, and developing client facing interactive dashboards, Report and dashboard development experience using Tableau (or similar BI tools), Experience in creating dashboard outputs,Create dashboards and interactive visual reports using Power BI, Creation of executive dashboards with advanced drill-through capabilities, Development experience in OBIEE dashboards, QlikView/QilkSense or other dashboard tools for data visualization, "Design necessary BI dashboards", " Attention to detail for Troubleshooting and maintenance", "Troubleshooting the reporting database environment and reports", "Troubleshooting database issues", " Presenting information through reports and visualization", "Nprinting, QlikSense"	
Perform data modelling (SQL)	"Analytical Asking for data modelling", ""Data Modelling", "Data modelling and Visualization", "Modelling and ETL tools i.e., SQL", "QlikView for Data modelling and Report building", "Analytical Asking for data modelling", "analysis of data modelling of data marts for reporting purposes", "Dimensional data modelling experience", "High level of experience in Data Modelling", "Data Modelling using the Kimball methodology", "Data modelling/Application modelling", "Some basic understanding of data modelling", "Data Modelling using Visio or SAP Power Designer", "Logical and physical data modelling", "Experience in tabular and dimensional data modelling"	**Survey, Job Ads, Literature Review**
Communicate effectively, verbally and in writing	"Communicate", "Communication - ability to communicate effectively between the client/sponsor and the representatives of the various sources of input data","Communicating with upstream teams to ensure data validity by means of schema contracts" "Communication of analytic insights to individuals and groups at multiple levels, both internal and external", "Communication skills (verbal and written)", "Strong verbal and communication skills ", "Ability to present ideas succinctly, in writing and verbally", "Strong communication skills", "Communicate effectively", "Communicate stories to the business that form the basis for actionable insight into data"	**survey, Job Ads, Literature Review**
Demonstrate problem-solving skills	"Problem solver", "Demonstrated ability to solve problems", "Excellent analytical and problem-solving skills "," Interact with clients in a variety of domains, who have a spectrum of challenging problems", "Problem solving", "Apply problem-solving techniques", "Analytical",	**survey, Job Ads, Literature Review**
Demonstrate excellent analytical skills	"Strong analytical skills", " Enables BI manager to make sound business decisions as a result of analytical insight"	**survey, Job Ads, Literature Review**
Perform Business Process Management	"Understanding business processes", "Identifying opportunities for improving business processes through information systems ", "Strong understanding of business process definition and re-engineering requirements", "Business process re-engineering", "Enterprise process mapping systems", "Understand and analyse business processes", "In-depth knowledge of process management", " Testing and QA business processes to ensure efficiency and productivity", "Proficient knowledge in implementing business methodologies"	**survey, Job Ads, Literature Review**
Code in a variety of programming languages (C, C++, C#, Python, Java,and R)	"Programming Coding in variety of languages", "Writing some programming", "Programming language skills", "Documentation and coding", "Strong programming languages"	**survey, Job Ads,**

	" Programming Coding in variety of languages (SAS, SQL, R, Python etc.)", "Familiar with programming languages: C, C++, C#, Python and Java" "Python/R/Java with machine learning algorithms such neural nets and SVMs", "Use multiple programming languages", "Exposure to C# and .NET Framework", "Exceptional coding skills (SQL, C#, other, Fluency in a programming language (Python, C,C++, Java, SQL"," Ability to adapt to programming environments based on the project at hand, "Understanding of Java skills", "SQL, Transact SQL (T-SQL)", "Writing SQL Programming", "SQL Query/Code Writing"	Literature Review
Elicit and document business and user requirements	"Talking to business to get requirements", "Understand customer requirements" , "Create business requirements analysis and design work packages for integrated software components", "Manage user acceptance of the requirements, scope and agreed timescales", "Translate business needs into technical specifications", " Understands business requirements to improve business performance", "Ability to hold elicitation sessions from a business and technical perspective", "Writing business requirements and user stories", " Ability to interpret data and present it in a non-technical way", " Ability to clearly and fluently translate technical findings to non-technical team business stakeholders to enable informed decision-making", " Writing user stories", "Identify and define business BI requirements through communicative processes", "Elicit user requirements", " Translate the data-driven insights into decisions and actions", "JAD Skills", "Relay technical concepts to non-technical staff members", "Excellent technical skills", "technical leadership", " Ability to convey complex technical terms to a non-technical audience", "Apply technical and business skills synergistically", "Translate business needs into technical specifications", "Applying technical expertise and researching, translating those business needs into technical specifications", "Technical Skills: use complex computer programs to mine data sources and look for trends", "Technical skills (Data warehouse, data modelling, data mining, Microsoft, "Knowledge of SQL queries, SQL Server Reporting Services (SSRS) and SQL Server Integration Services (SSIS)", "Understand the technical landscape and bank wide architecture that is connected to or dependent on the business area supported in order to effectively design & deliver data solutions" , "Excellent verbal and written communications skills with the ability to present complex information in a clear and concise manner to a variety of audiences, including technical and non-technical individuals", "bridge communication between technical and business teams"	survey, Job Ads, Literature Review
Apply Business Analysis techniques	"Business analysis skills", "Business Objects", "Business context - a good understanding of the business aspects and strategies that govern input data to understand the relationship of different input domains", "Business Analysis", "Assists in the preparation of proposals to develop new systems and/or operational changes", "Data and business literacy", "willingness to understand the business context", " Business acumen", "Business Analysis (including business process mapping)", "Ability to create a storyline around the data to make it easy to interpret", "Understanding business processes, "Business Analysis (including business process mapping)", "Demonstrating the ability to facilitate and guide the completion of Business Analysis Artefacts", "Apply business analysis tools and techniques to continuously improve thinking and solutions", "Demonstrated experience of business analysis", "" Identify and define the needs of a business", "Establish BI standards and best	survey, Job Ads, Literature Review

	practice", "Drafting functional specifications", " Demonstrating the ability to facilitate and guide the completion of Business Analysis Artefacts", "Ability to assimilate and apply relevant business principles"	
Employ data mining skills	"SSAS", "Data Mining and Data Warehousing", "Data mining", "Employ data mining skills", "Apply data mining techniques, text mining, and statistical analysis for effective decision-making ", "Data Mining", "Mine and aggregate raw data through real-time dashboards", "Data warehouse design (e.g. dimensional modelling) and data mining", "Experience in data mining", "Familiarity with data mining algorithms", "Business Processes; Data Mining; Data Warehousing", "Strong understanding of data mining models, structures, theories, principles and practices"	**survey, Job Ads, Literature Review**
Analyse data using statistical and platform analytics tools	"System and Data Analytics", "Insights Driven Data & Analytics strategy development", "SAP Analytics", "Data Analytics", " SAP Analytics", "Identify, discover and explore patterns", "Find patterns and themes using past events and current data", "Apply data mining techniques, text mining, and statistical analysis for effective decision-making", "Identify, discover and explore patterns", "Apply statistical techniques to data", "Analyze the data with sophisticated analytical tools and techniques"	**survey, Job Ads, Literature Review**
Provide training and coaching	"Provide support for reporting systems and infrastructure", "Management of users and user roles", "Knowledge translation", "Ability and willingness to coach and give training to fellow colleagues when required."Excellent influencing and coaching skills", " Provide training to BI teams and BI users", "Learn new emerging skills"	**survey, Job Ads, Literature Review**
Apply Project management procedures, tools, techniques etc.	"Project management", "Ability to meet tight deadlines and thrive in a multi-project environment", " Ability to work to strict deadlines", Able to shape the project delivery approach and lead the execution plan for designing and deploying cutting edge machine learning solutions in business environments", "Define BI project scope", "Manage change with regards to BI operational and project requirements", "Negotiate and influence change", "Define BI project scope", "Plan and execute a BI project", "Adapt to, and manage change and expectations concerning BI delivery","Manage change with regards to BI operational and project requirements", "Analyse business performance", "Prioritize business requests", " Manage projects", "Able to shape the project delivery approach and lead the execution plan for designing and deploying cutting edge machine learning solutions in business environments", "Determine appropriate actions and complete projects with little direction", "Ability to meet tight deadlines and thrive in a multi-project environment", " Ability to work to strict deadlines", "API integration projects, software upgrades", "Ability to create APIs",	**survey, Job Ads, Literature Review**
Carry out Strategy planning and execution	"Strategy Planning and execution", "Advanced Planning skills", " Ability to think strategically about how to use data to drive competitive advantages","Measure success and progress of the business", "Think strategically", "Control budgeting and forecasting for BI projects", "budget management","Link BI to corporate strategy", " Strong desire to create strategies and solutions that challenge and expand the thinking of everyone around you"	**survey, Job Ads, Literature Review**
Build real time systems that integrate with the rest of the stack	"Build real time systems that integrate with the rest of the stack", "We are contracted to deliver near real time data to our clients so if any snag hits the pipeline it has to be promptly identified and fixed", "Work with data in real-time"	**Survey, Job Ads, Literature Review**
Configure and use a variety of enterprise and productivity tools	"Strong understanding and experience in configuring Microsoft Dynamics 365 ERP, Interfacing the Microsoft Dynamics 365	**Survey,Job Ads**

	ERP to third-party", "Proficiency in software tools (Word, PPT, Excel, Power BI, Visual Studio, SQL Management Studio, etc.)", "Advanced Microsoft Excel", " Proficient in MS Office suite", "PowerPivot, Business Objects, SYBASE"	
Build and write pipelines that move and transform data	**"Writing pipelines that move and transform data", "optimising and building big data pipelines", "Fixing any potential bugs in the data pipeline", "Data pipelines follow the pattern of garbage in garbage out we have to ensure the teams which feed us data sends us high quality data where meaningful insights can be made. "**	**Survey,Job Ads**
Design, develop and maintain business intelligence solutions	**Ability to design and develop different data models including Kimball or any relational model, BI development (Datamart design and development), "Designing, developing and maintaining business intelligence solutions", "Working with security design principles", "Apply design principles to the development of BI solutions", " Design, build and deploy BI solutions (e.g., reporting tools)", Manage data quality", "Design IT infrastructure", "Design and develop new computational techniques to solve business problems", "Implementing Business Intelligence Solutions", "Object-oriented design, data structures and algorithms",**	**Survey,Job Ads, Literature Review**

APPENDIX 15 - COMPARISON OF JOB ADVERTISEMENT SKILLS OF BA/BDA